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Address on Heredity in Relation to Insanity, given to the Members of the London County Council, at the County Hall, S.W., on June 26th, 1912.

By F. W. Mott, M.D., F.R.S., F.R.C.P.,
Pathologist to the London County Asylums.

Mr. Alfred O. Goodrich, J.P., *Chairman of the Asylums Committee, in the Chair.*

Mr. Chairman and Gentlemen,—Allow me to thank you for doing me the honour of asking me to give an address upon the subject of heredity in relation to insanity. It is a subject which I have been studying for several years; the more deeply I consider the question, the more I find there is to be done before we shall be safe in drawing conclusions regarding practical questions dealing with the prevention of insanity, which I shall touch upon more fully later.

The subject of heredity, in its broad aspect, is one of national importance and interest, as it affects many social and legislative questions. The interest taken by the general public in heredity is a sign of social progress. People are beginning to recognise the truth of Prof. Arthur Thomson's dictum: "The present is the child of the past; our start in life is no haphazard affair, but is vigorously determined by our parentage and ancestry; all kinds of inborn characteristics may be transmitted from generation to generation."

All the modern doctrines of human heredity were foreshadowed by the ancient philosopher Lucretius, who, in 'De Rerum Naturæ,' says: "Sometimes, too, the children may spring up like the grandfathers, and often resemble the forms of their grandfathers' fathers, because the parents often keep concealed in their bodies many first beginnings mixed in many ways, which, first proceeding from the original stock, one father hands down to the next father, and then proceeding from these, Venus produces forms after a manifold chance, and repeats not only the features, but the voice and hair of forefathers, and the female sex equally springs from the father's and males go forth equally from the mother's body, since these distinctions no more proceed from the fixed seed of one or other parent than our face and bodies and limbs. Again, we perceive that the mind is begotten along with the body and grows up together with it and grows old along with it."

Of the broad principles of human heredity we know very little more than this ancient philosopher. Science, aided by the microscope, has taught us much concerning the material basis of inheritance; it has shown that plants and animals are reproduced on the same common plan of a dual inheritance from the male and female germs. Let us briefly consider the union of the male and female germs or fertilisation in the higher animals, for it will help you to understand some of the problems of inheritance.

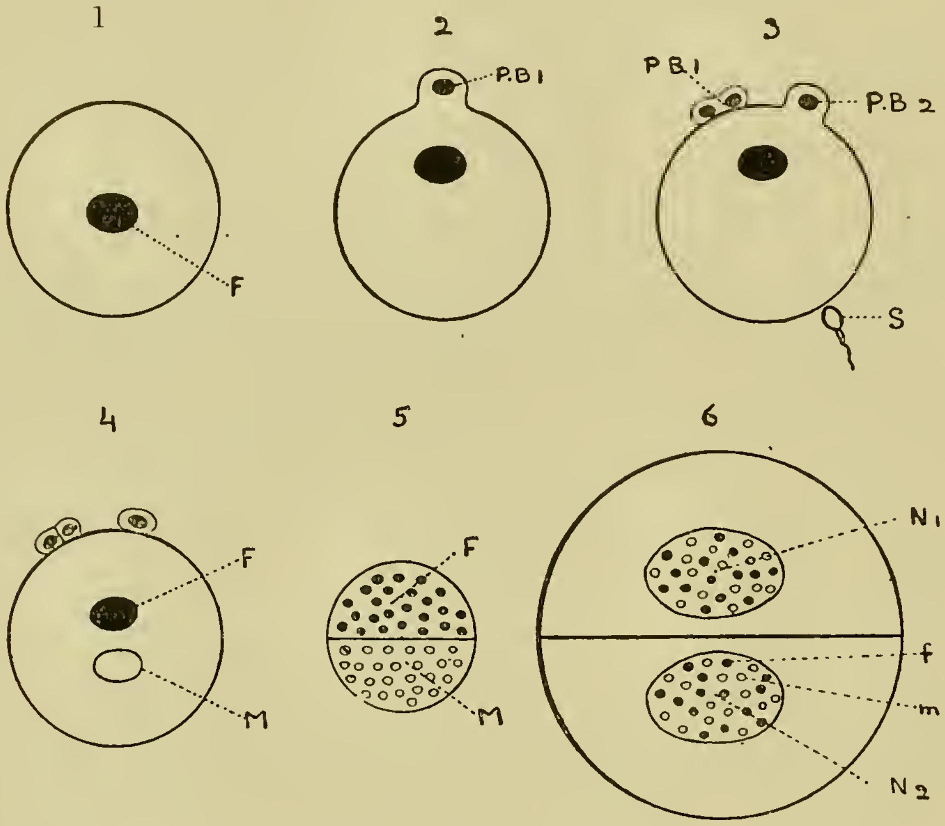

Fig. 1.—(1) Diagram of egg-cell before ripening. (2) Maturation or ripening of the ovum casting out of half of the nucleus to form the first polar body. (3) Formation of second polar body and entry of spermatozoon (S) into egg. (4) Approximation of (M) male and (F) female germs. (5) Enlarged diagram of the two germs (F and M) before the first cleavage of the egg. (6) Enlarged diagram of egg after first cleavage. P. B1. First polar body. P. B2. Second polar body. S. Sperm. N1 and N2. Nuclei of first two cells of organism, containing (F) representative particles of the female germ and (M) representative particles of the male germ.

The male germs are formed in countless millions in the male reproductive organs. The female germ-cells, ova or egg-cells, are contained in the ovaries; they are about 40,000 in number at birth; the germ which constitutes the material basis of inheritance is a minute round body in the cell (Fig. 1 F). When an ovum ripens (Fig. 1, ^{2}, ^{3}), which occurs periodically, one half of this germ is cast out of the cell. Why is this? It is to make way for a union with the incoming male germ, the bearer of the potential inheritance from the male as the female germ is from the female. These two germs constitute the woof and the warp of the material basis of inheritance; while the male germ brings in a body called the centrosome, which acts as the shuttle which weaves the woof into the warp. The main substance of the egg-cell surrounding the germinal substance or nucleus provides the material out of which fresh nuclear material is built up until division of the nucleus occurs, Fig. 1, [6], the cell then divides; this process is continually repeated. In the case of the egg, *e. g.* that of the chicken, there is sufficient material to build up the young chick; in animals, however, the fertilised egg-cell receives its nutrition after a short time from the blood of the mother.

The reason why I have endeavoured, in simple language, to explain these facts to you is in order to make you better understand the differences between congenital disease and true hereditary disease. As soon as the fertilised ovum, which is to form first the embryo and then the child, is nourished by the blood of the mother, it is liable to be affected by poisoned states of her blood. The best example I can offer of this is syphilis affecting the maternal blood, whereby the embryo is killed or the child is born with congenital syphilis. But supposing the father is suffering with syphilis and the mother is healthy and free from latent syphilis and remains so, will the children be affected? My answer is, No! Because it is essential that the specific organism of syphilis should be conveyed by the male germ into the ovum, and this is physically impossible. But you may ask: Can the male germs be in no way affected by the fact that the man had had syphilis, or that he had been a chronic drunkard, or suffered with chronic lead poisoning? This is a crucial point in the study of heredity. The majority of biologists deny the possibility of the transmission of an acquired character, and I would agree up to a certain point that there is no evidence or proof that an acquired character can be transmitted. That a father who drinks heavily and sees his wife and family starving transmits the *desire* to drink in his offspring is illogical and unproven; he may transmit that inborn character which will lead to his offspring drinking, viz. lack of moral sense and feeble will. You naturally ask: Are the Scriptures wrong in saying "that the sins of the fathers are visited upon the children even to the third and fourth generation"? and when I come to deal with the question of insanity and how I believe Nature is continually striving to end or mend degenerate stocks you may ask: What then is the reservoir which is continually supplying degeneracy? Is it a continuous fresh generation of poor types consequent upon the pathological factors of modern social conditions, or is it that natural selection and survival of the fittest are less effectual in weeding out poor types? How far is medical science, legislation and collective responsibility replacing family responsibility thereby interfering with natural selection and survival of the fittest? Let us view the question from a physiological standpoint. I will take the male germs which are continually being produced in countless millions for the greater part of a man's life. Each germ is the bearer of an extraordinary specific potential energy; it produces effects far more complex and wonderful than the emanations of a similar sized speck of radium. The reproductive organs that produce these germs are contained in the body, nourished by the same blood and lymph, and although one cannot but admit that physiology proves that Nature has protected in a marvellous way the brain, which is essential for the preservation of the individual, and the reproductive organs, which are essential for the preservation of the species, and moreover has established, by subtile bio-chemical influences in the blood, a correlation of functions of the two, nevertheless as the brain suffers in the production of specific energy, as shown by failure of its higher functions by prolonged poisoning of the blood, so the male germ-cells, which are continually building up the male-germs, out of constituents taken from the blood, may, by analogy, suffer in their specific energy and vitality. If this devitalising agency is carried on in several successive generations, and especially if reinforced by a similar loss of specific energy in the female germs from similar and other causes, weakly types of offspring will be produced, and these weakly types, being more susceptible to infective diseases, will be cut off early by invading microbes, especially by tuberculosis. But, you may ask, is the transmitted lack of vital energy generally, enough to account for mental degeneracy? Mental energy is mainly used up in the exercise of will-power and attention in acquiring knowledge and making new adaptations to environment and controlling and regulating the instincts, appetites and desires to the best advantage of the individual in the struggle for existence in the social life. Now a healthy mind can only exist in a healthy body, and the proper storage of mind energy and its liberation, as well as recuperation necessary for a well-balanced mind, are largely dependent upon a good and virile constitution; whereas the higher functions of the mind on the side of feeling, viz. imagination and the affective nature, are specifically inherited, and more dependent upon an inborn variation from the normal average mind. When the mingled natures of two separate parents by a happy chance leads to a combination of energy from one and imagination from the other in the dual inheritance, then a great genius may arise, as in the case of Goethe, who poetically refers to his own hereditary endowments:

> "Von Vater hab ich die Statur,
> Des Lebens ernstes Fuhren,
> Vom Mütterchen die Frohnatur
> Un Lust zu fabulieren."

Which, freely translated, means that he derived his physique and energy from his father and his poetic imagination and affective tone from his mother. The infamous Roman Emperor Commodus resembled his father, the great Marcus Aurelius, in his form and features, and the licentious Faustina, his mother, in his character.

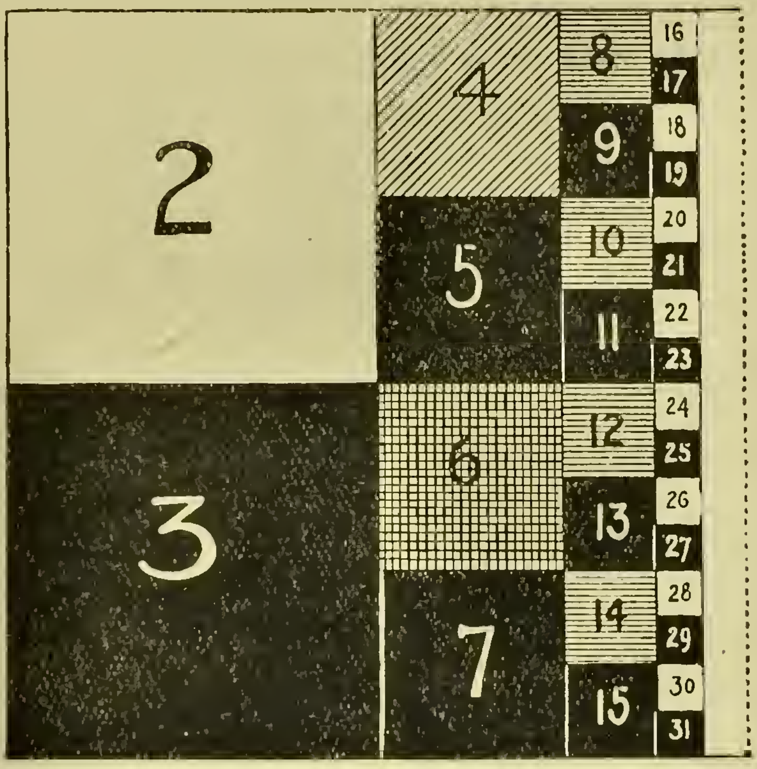

Fig. 2.—Diagram illustrating Galton's 'Law of Ancestral Inheritance' (after Galton). The figure was originally due to Mr. A. J. Meston ('The Horseman,' Chicago, December 28th, 1897).

Laws of Heredity.

In order to make my future remarks clearer, let me briefly refer to two laws of heredity. I will commence with the Law of Ancestral Inheritance of Galton. According to this law each germ, male and female, contains on an *average* representative particles or germinal determinants derived from the two ancestral stocks in definite proportions. This diagram illustrates my meaning (Fig. 2*). The total dual inheritance is represented by the whole square. Thus one quarter comes from each parent (2 and 3), one sixteenth from each grandparent, and so on, the sum of the total inheritance being equal to one, as it should be. "It is, as you see, the property of this infinite series that each series is equal to the sum of those that follow. Thus an inheritance is not merely dual, but through the parents it is multiple, and the *average* contributions made by grandparents, great-grandparents, etc., are definite, and diminish in a precise ratio according to the remoteness of the ancestors" (Thomson). However true this law may be when applied to the average inheritance of masses of people, it does not apply to individual cases. Galton himself recognised this, for he says: "Though one half of every child may be said to be derived from either parent, yet he may receive a heritage from a distant progenitor that neither of his parents possessed as personal characteristics." Again, speaking of particulate inheritance, he remarks: "All living beings are individuals in one aspect, composite in another. We seem to inherit, bit by bit, this element from one progenitor, that from another, in the process of transmission by inheritance, elements derived from the same ancestor are apt to appear in large groups, just as if they had clung together in the pre-embryonic stage, as perhaps they did." They form what is well expressed by the word "traits"—traits of feature and character, that is to say, continuous features, not isolated points. The offspring of parents possess a mosaic of inheritance bearing usually a more or less similarity, yet the mosaics of characters, whether bodily or mental, are not in any way identical except in the case of identical twins. Now there is a reason for this. Identical or similar twins are the result of fertilisation of one ovum containing two germs of identical substance. Before now leaving Galton's law to pass on to a brief description of the Mendelian doctrine let me call attention to his important researches on the history of twins, for probably nothing has shown more conclusively the dominant influence of heredity on character. He found that similar twins living in a different environment nevertheless remained similar in temperament and character, while dissimilar twins brought up and living in the same environment remained dissimilar. These dissimilar twins, however, were the product of two separate ova. This shows that every germ has a different potentiality and inheritance.

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* Fig. 2 has been taken from Arthur Thomson's 'Heredity,' with the kind permission of the author, and John Murray, the publisher.

MENDELIAN DOCTRINE.

It is only within the last twelve years that the important researches of Gregor Mendel in the monastery of Brunn have been brought to light and their vast importance recognised. He studied hybridisation in peas, and as a result of many years of patient research demonstrated the segregation in the germs of unit characters. I will cite one of his experiments in illustration of the segregation of alternate unit characters. The alternate characters are tallness and shortness; it might be thought that the hybrid would be something between the two, and so it would if the characters tallness and shortness were not segregated in the germ. Now how did he prove this segregation? Well, he took a tall pea flower and cut off all the stamens which are the bearers of the male germs, and fertilised it by brushing the pollen obtained from a dwarf pea flower on to the style; he thus introduced male germs bearing the character of shortness to female germs bearing the character of tallness*. The seeds of this artificially fertilised plant were sown and only tall plants resulted. We will call this family F_1. Now he allowed these hybrid plants to be self-fertilised, and what was the result when he sowed the seeds of this second family F_2? There were three tall plants and one short, and he found that one of the tall plants would produce nothing but tall pea plants and that the dwarf plant would produce nothing but dwarfs, that is, there was a pure strain; the other two tall plants were hybrids and their seeds produced again three tall plants and one dwarf (*vide* Fig. 3). We say, then, that tallness is dominant and dwarfness is latent recessive.

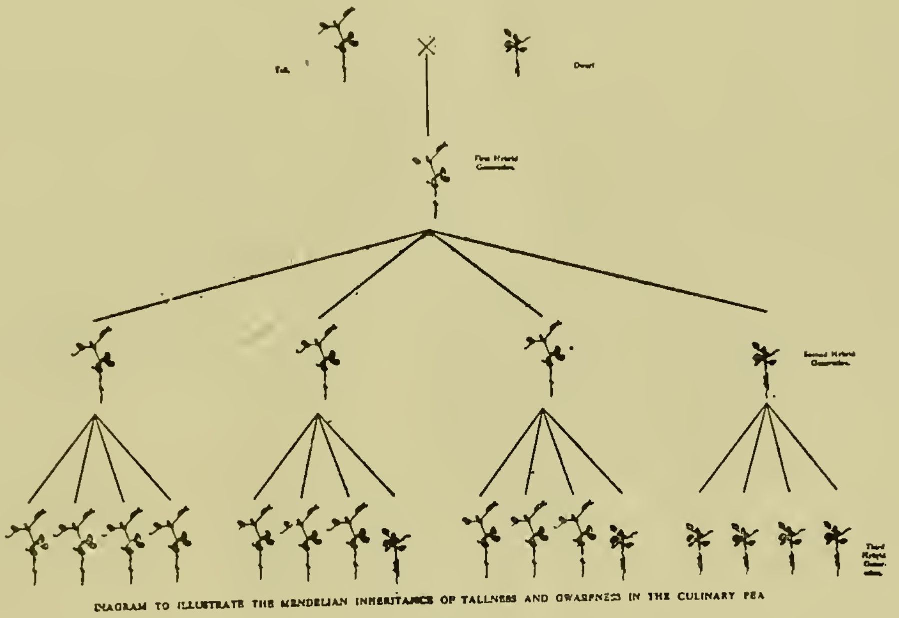

DIAGRAM TO ILLUSTRATE THE MENDELIAN INHERITANCE OF TALLNESS AND DWARFNESS IN THE CULINARY PEA

FIG. 3.

In the diagram (Fig. 4) you see the parents are tall and short. In the hybrid family F_1, where all the plants are tall, you have nevertheless an equal number of representative particles bearing shortness and tallness which are indicated by short and tall lines in the male and female germs. Now the chances are that tall will meet with short twice as often as either tall with tall or short with short, and this is what we have seen actually happens, for in F_2 after self-fertilisation there are three tall plants and one short, but two of these tall plants are hybrids and have characters of tallness and shortness in each germ. This is shown by the fact that if these hybrids of F_2 generation are self-fertilised and the seeds sown we shall have in F_3 the same result as in F_1, viz. three tall and one short. Tallness is the dominant character, shortness is recessive and latent. Mendel studied many other alternate unit characters, such as smooth and wrinkled coats, green and yellow coats of peas.

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* Figs. 3 and 5 have been taken from A. D. Darbishire's 'Breeding and the Mendelian 'Discovery,' with kind permission of the author, and Messrs. Cassell & Co., the publishers.

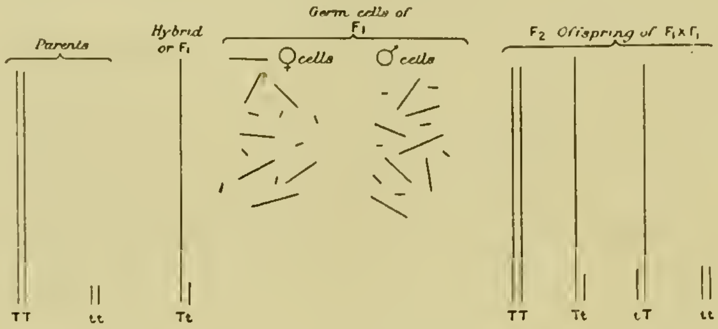


FIG. 4.—A diagrammatic representation of the germ-cells of the tall and short plants, and of their combinations (Bateson).

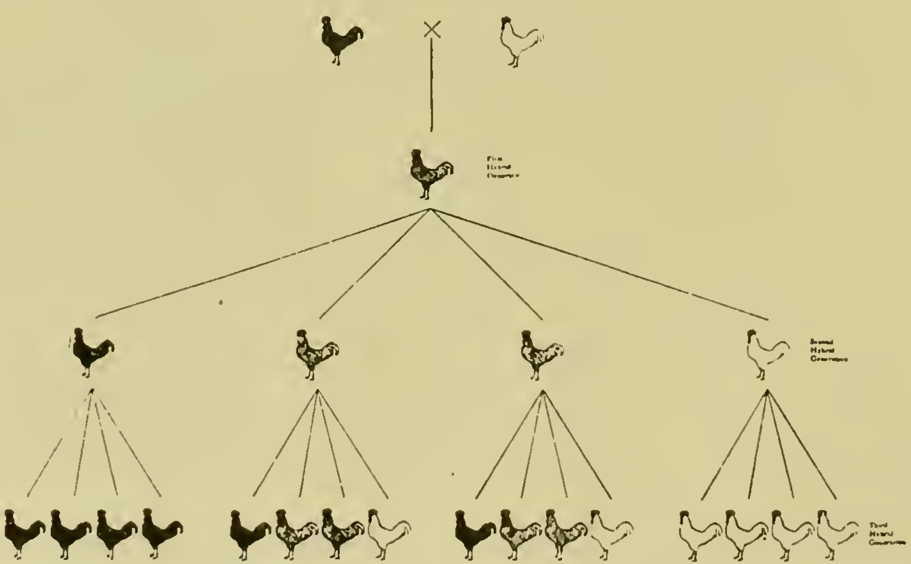


DIAGRAM TO ILLUSTRATE THE MENDELIAN INHERITANCE OF COLOUR IN THE ANDALUSIAN FOWL

FIG. 5.

One of the most striking instances of Mendelism is afforded by the breeding of the blue Andalusian fowl (Fig. 5). This bird is a hybrid obtained by crossing a black with a white fowl, as the diagram shows; the first generation of hybrids are blue Andalusians. But if two birds of this strain are mated it will be found that they do not breed true, for besides the blue birds which hatch out, there will also be a certain number of blacks and a certain number of whites partially splashed with black, but white predominant. If the blacks of this second hybrid generation are mated with blacks only blacks will be produced; likewise, if the whites are mated with whites only whites will be produced; while if the blue are mated again we shall have in the third generation the proportion of two blues, one black and one white. Now the blacks and whites are regarded as "wasters" by the breeders, consequently it would be more profitable to cross a black with a white fowl to produce all hybrids. The black fowl is only partially dominant to the white, and differs therefore from the tall pea, which is completely dominant. The blue colour of the fowl may be regarded as an intermediate between the black and white; the important point to notice, however, is that the hybrid, whether of the first, second, or third generation, or any future generation, is distinguishable from both parents of the cross, not only by the results of the cross-breeding, but by

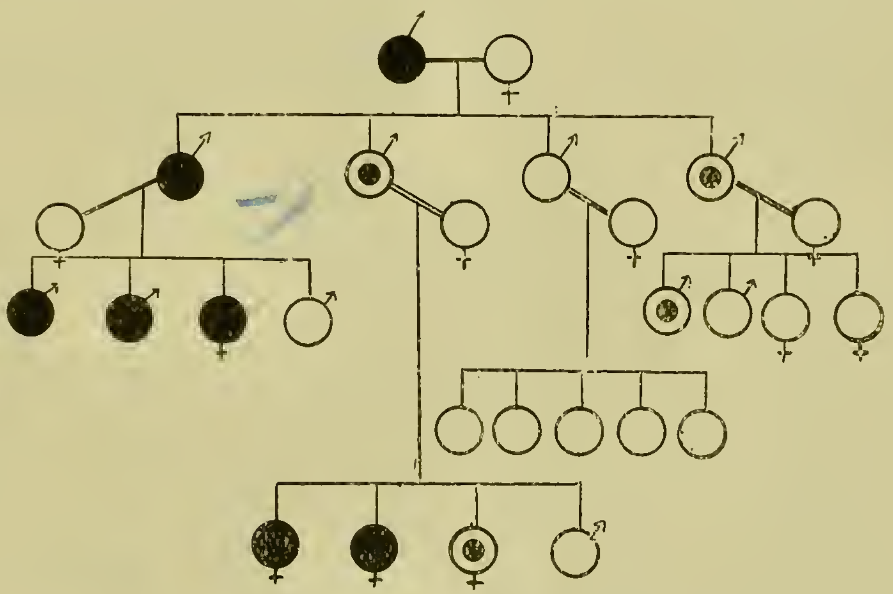


Fig. 6.—Pedigree showing polydactylism. Black circles indicate polydactylism, and circles with black centres partial polydactylism. The chart is very suggestive of Mendelism.

visible characteristics. "For fifty years the blue Andalusian has been bred, and it comes true to type no more now than when the attempt to fix it began" (Davenport).

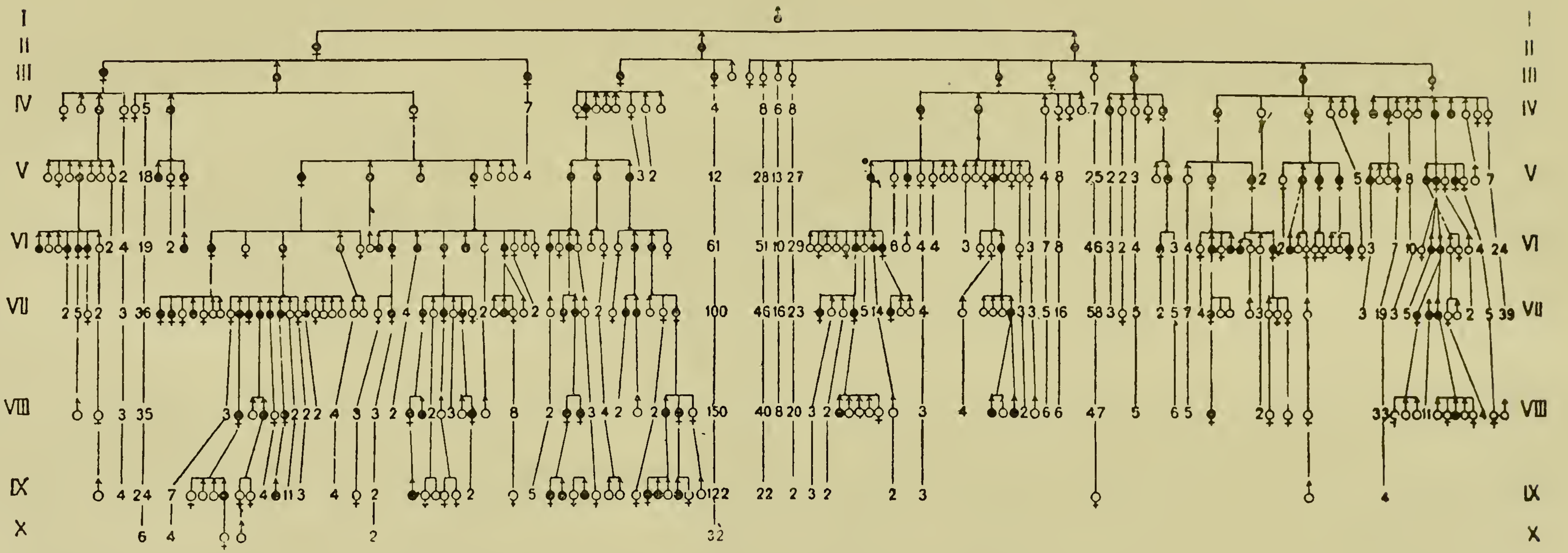
In a discussion on heredity and disease at the Royal Society of Medicine the two greatest authorities on heredity in this country—Professor Karl Pearson and Professor Bateson—took part. The latter said: "I think I shall have no difficulty in showing you that the conclusions to which Mendel came are applicable in many cases to the descent of disease or congenital deformity in man." Prof. Pearson, while admitting the importance of the work of Mendel and his followers, stated that it was limited to the observation of segregation of characters in the germ. Perhaps the only example of Mendelism in the human subject that can be cited as showing dominant and recessive characters in the proportions found by

Mendel in his experiments on peas is afforded by eye colour. Certain hereditary defects or abnormalities also are claimed by Mendelians as showing dominance and recessiveness in the proportion of 3 to 1. Thus a pedigree of polydactylism which I have constructed from an account given by Huxley, based upon observations made by Réaumur on the descendants of a Maltese named Gratio Kelleia, who had six fingers and six toes, shows Mendelism. Other examples of variation of all the four terminals of the limbs occur and are repeated in successive generations, *e. g.* lobster claw, of which there is a remarkable example at Claybury; brachydactylism, in which there is a deficiency of a bone in all the digits. Very possibly some of the cases which we believe arise *de novo* are really due to a recessive latent character made dominant by reinforcement caused by mingling of the germs of two stocks in which the abnormal character was latent. These and other variations from the normal are sometimes termed spontaneous, but every effect owns a cause although we may not be able to discover it.

Modes of Transmission of Heritable Diseases.

There are various modes of transmission of heritable disease, and they may be divided into three groups. *The first group* contains certain hereditary diseases or defects which are transmitted through successive generations and affect members of both sexes; the sexes may be affected sometimes equally, sometimes unequally; the majority of human heritable conditions or tendencies to diseases, *e. g.* tubercle, insanity, epilepsy, and nervous disease, are transmitted in this manner. Many pedigrees have been recorded which show that some well-defined abnormal condition or defect may descend uninterruptedly through five or six generations, and even more than this. The Hapsburg lip is an instance of this, polydactylism, brachydactylism, white tufts of hair on the scalp, defective dental enamel, cataract and other diseases and defects of the eye, but the most remarkable of all is a pedigree of congenital stationary night-blindness published by Mr. Nettleship. This remarkable human pedigree comprises nearly 2000 individuals, and extends back for ten generations. It commenced, so far as is known, with Jean Nougaret, born in 1637, and subsequently 135 descendants of this individual were affected with a defective vision in a dull light.

In the second group the inheritance or transmission is discontinuous or interrupted; the disease skips a generation or even two generations.



* Fig. 7.—Descent of a form of stationary night-blindness (condensed from the chart published by Nettleship, based on Cunier's records with later additions). Only those families which contain affected members are here set out in detail. Black symbols show the night-blind individuals. The descent is always through the affected, showing the condition is due to a dominant factor.

* By kind permission of Prof. Bateson.

Albinism or absence of pigment is an example of this group. Pedigrees of this condition show that albinism—absence of pigment—is recessive; occasionally the marriage of perfectly normal blood relatives, *e. g.* cousins, each having this character latent in the germ-cells, may result in one or more of the offspring being albinos.

In the third group the transmission is not only discontinuous or interrupted in successive generations but the manifestation is confined to the male sex; moreover, there is this extraordinary peculiarity, the disease can be transmitted by the female sex in which the disease does not appear. The most striking examples in this group are Daltonism or colour-blindness (Fig. 8), and hæmophilia (Fig. 9), or the tendency to bleed.

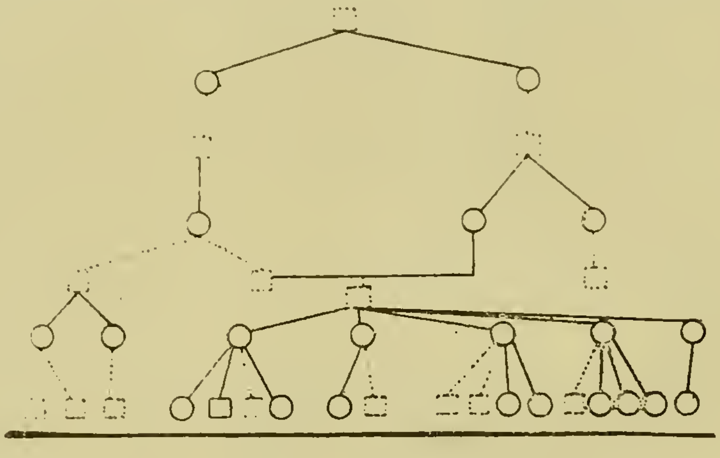


FIG. 8.—Squares denote males, and circles females. Dotted figures denote Daltonism.

There are also a number of rare nervous diseases due to germinal defects which run in families. But let us leave these rather rare abnormalities and pass on to the important subject of heredity in relation to epilepsy, insanity and degeneracy in general. Every insane patient should be regarded as a biological study. To say merely that one of his ancestors was insane, and that therefore he has a bad heredity and to label him thus, as is the common custom, is absurd. What we should aim to ascertain is, what he was born with—"nature"—and what has happened to him since birth—"nurture." The causes of a person becoming insane are seldom simple; they are in varied degree inborn tendencies which we may term

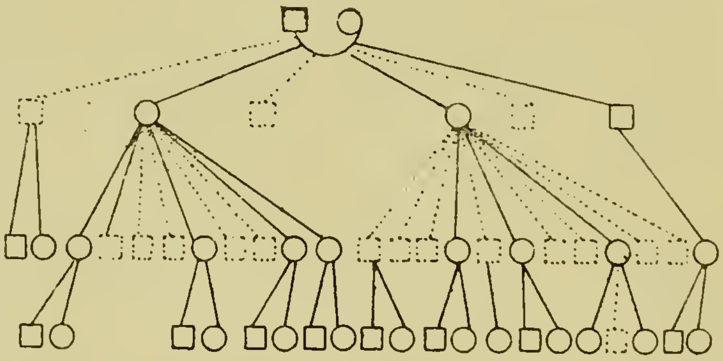


FIG. 9.—Squares denote males, and circles females. Dotted figures denote hæmophilia.

the neuropathic taint combined with some form of mental or bodily stress. But time will not permit me doing more than discuss the hereditary inborn tendencies. The construction of a pedigree will often answer the question, Whence came the tendency? What we want to know is, did the patient come from good stocks or bad stocks? Was there physical or mental defect both in maternal and paternal stocks? The fact that a cousin was insane or even several members of a large stock does not mean necessarily a bad heredity; often, indeed, with several insane members there will be found men of talent, even of genius, besides numbers of members, men and women, of average civic worth. A bad stock is where we find a large number of members exhibiting various forms of degeneracy besides insanity, *e. g.* feeble-mindedness, epilepsy, criminality, pauperism, inebriety, syphilis, tuberculosis; in fact, a general low standard, mental and physical, in stem and branches of the family tree, the further growth of which should be cut off. A study of numbers of pedigrees has confirmed me in the truth of the conclusion which Maudsley emphasises in his philosophic work, 'The Pathology of Mind.' First that a person does not inherit insanity but a predisposition or tendency, and secondly that the tendency comes from the stock. Nor need the unsound strain in the stock show itself in any form of actual insanity; it may appear in some allied nervous disorder, in hypochondriasis, in suicide, in feeble-mindedness, in dipsomania, in epilepsy in its manifold forms and other periodical nerve-storms, in eccentricity, in religious fanaticism, in the melancholic suspicious temperament, in selfish cunning, avarice and meanness.

If defects, abnormalities, diseases or predispositions to disease, *e. g.* insanity and epilepsy, are continually arising by variation in the germ, and if, as we have seen, these hereditary defects are not swamped out by mixture with normal stocks in a series of generations, what has prevented the whole race being infected and becoming degenerated? It is this: there is always the tendency to regression to the normal average of the species and of the race, operating with natural selection. Nature, unmindful of the individual, mindful only of the species, in its operation of survival of the fittest by natural selection, said to the blind, the halt, the deformed, the lame, the diseased and feeble in mind and body, "Thou shalt not live." In this respect Nature had no choice; her only mode of prevention of multiplication of the unfit was to exterminate them. This it did by wars, famine and pestilence, and by increasing their susceptibility in successive generations to ubiquitous poisons and microbes, *e. g.* alcohol, tubercle and syphilis. The mentally and physically strong alone could survive. Another of Nature's methods is to intensify the disease or predisposition to disease by inheritance and bring it on at an earlier age, or even at birth; thus anticipation or antedating, as Darwin termed it, renders the unsound members of the stock less able to survive in the struggle for existence, and less able to propagate by reason of the disease impairing seriously their mental and physical powers. Although this is still operating, as we shall see, in the case of insanity, epilepsy, and the neuropathic taint generally, it is ineffectual; for man, by his control of Nature's process of selection, has interfered with the laws of natural selection and survival of the fittest, and unless, as Ray Lankester says, "man enters fully into the possession of his kingdom" and prevents the perpetuation and multiplication of poor types, racial degeneration must follow. The proper attitude to take up in the question with regard to the perpetuation of poor types is that laid down by Huxley: "We are sorry for you; we will do our best for you, but we deny you the right to parentage. You may live, but you must not propagate." To no class of people does this principle apply with greater force and urgency than to the mentally defective or feeble-minded. It is only within the last century the feeble-minded had much chance of survival, or of handing down their mental and physical defects to successive generations. But all those causes, which by Nature's mode of selection weed out the poor types, have been controlled by man, without supplying any alternative scheme such as he uses with success in his breeding of domestic animals, when he employs only the best types for propagating. At the present time in Great Britain restriction of families is occurring in one half or two thirds of the people, including nearly all the best, while children are being freely born to the feeble-minded, the criminal, the pauper, the thriftless casual labourer and other denizens of the one-roomed tenements of our great cities. The poor alien Jew and the poor Irish Roman Catholic, who, owing to their religious teaching, do not restrict their families, may also be included. Prof. Karl Pearson keeps warning us that 25 per cent. of our population, made up largely of the before-mentioned poor types, is producing 50 per cent. of our children, and if this goes on must lead to racial degeneracy.

The Investigation of Relatives in the London County Asylums.

I will now pass on to a summary of the work which has been done in the Pathological Laboratory on heredity in relation to insanity. Four years ago I initiated a card system of relatives who are at present, or have been, in the London County Asylums. The reason for doing so was to see if the anatomical features of the brain—the organ of mind—showed like the physiognomy features of resemblance in the fissures. Dr. Edgar Schuster has carefully examined and reported on the brains of a mother and daughter and of two brothers, and in a long and valuable communication has demonstrated the many points of similarity that exist. Since there is a correlation of structure and function throughout Nature we may presume that this affords an indication of a resemblance in the raw material of mentality in members of the same family.

Table showing Number of Cases Reported from each Asylum.

Asylum.	Died.		Discharged.		Transferred.		Resident.		Total.		Total.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M. and F.
Banstead . . .	63	55	30	40	5	3	74	66	172	164	336
Bexley . . .	48	61	39	47	7	8	117	113	211	229	440
Cane Hill . . .	37	31	15	19	11	7	52	108	115	165	280
Claybury . . .	55	67	38	57	10	17	81	125	184	266	450
Colney Hatch . .	93	88	57	71	4	7	103	142	257	308	565
Hanwell . . .	51	48	34	60	7	5	63	136	155	249	404
Horton . . .	39	27	21	27	10	8	83	101	153	163	316
Long Grove . .	12	9	25	33	3	5	64	88	104	135	239
The Manor . .	—	13	—	11	—	2	1	44	1	70	71
The Colony . .	2	—	1	—	3	—	9	2	15	2	17
Total	400	399	260	365	60	62	647	925	1367	1751	3118

Table showing Proportion of Deaths and Recoveries amongst "Relative" Cases.

	Discharged.	Transferred.	Died.	Resident.	Total.
Males	260 = 19·0 per cent.	60 = 4·4 per cent.	400 = 29·2 per cent.	647 = 47·3 per cent.	1367
Females . . .	365 = 20·8 per cent.	62 = 3·5 per cent.	399 = 22·7 per cent.	925 = 52·8 per cent.	1751
Total . . .	625 = 20·0 per cent.	122 = 3·9 per cent.	799 = 25·6 per cent.	1572 = 50·4 per cent.	3118

From a few hundred cases at the commencement of the inquiry the list has rapidly increased until it has now reached 3118 cases. This has involved a vast amount of work, and I wish to express my indebtedness to all the superintendents and medical officers, to the Clerk of the Asylums

Committee and his staff, and to my assistants, especially Mr. Mann, for the assistance they have afforded me in this inquiry. It would take far too long a time to give more than a summary of the results obtained. There is yet a good deal to be done, but I think the following conclusions may be arrived at:

The 3118 cases are made up from 1450 families. At the present time in the London County Asylums there are 725 so closely related as parents and offspring, brothers and sisters. *À priori*, this, to my mind, is striking proof of the importance of heredity in relation to insanity, for we cannot suppose that 20,000 people of the four and a half millions of people in the county of London brought together from some random cause would show such a large number closely related as 3·6 per cent.

COMPARATIVE STATISTICS OF HEREDITY IN ASYLUM AND HOSPITAL CASES.

My late house-physician, Dr. Thomas, carefully investigated and compiled the pedigrees from thirty-two of my hospital patients admitted for various diseases. There were in these pedigrees 1000 living representatives and 250 dead; there were eight who had been in asylums and in eight others fits were chronicled. Two of the pedigrees furnished nearly all the cases of insanity and epilepsy, but these two patients were suffering from nervous disease. One was a patient suffering from neurasthenia, and in the pedigree there were members who suffered from epilepsy, migraine, insanity, hysteria, deaf-mutism and imbecility, significant of a neuropathic taint in the ancestral stocks; and the other was a patient suffering from exophthalmic goitre, and there were several neuropathic members in this stock. I have ascertained that a far greater number would be found in the stocks of any thirty-two insane patients.

THE NEUROPATHIC TENDENCY IN A STOCK.

Everybody knows the value of coming from a good stock or a bad stock, and in judging whether an individual who is insane should marry and propagate, or not, it is absolutely necessary, as the study of a large number of pedigrees shows, that we should consider (1) the nature of the insanity and (2) what was the cause. Certain forms of insanity are much more likely to be transmitted than others, either in the same form or still more frequently in some other form indicative of the neuropathic taint. The card system shows that epilepsy, recurrent insanity and delusional insanity are more liable to be transmitted in the same form than in other forms of insanity; general paralysis, which is now recognised as an organic brain disease caused by syphilis, is not much influenced by a neuropathic heredity, and cases of general paralysis, consequently, do not figure largely in these relative cases.

In considering the question of marriage and propagation, a study of these relatives and pedigrees convinces me of the importance of looking back into the stocks and ascertaining whether there are many lines of defective heredity, and whether, with some lines of defective heredity, there are lines of sterling worth, for often enough with insanity and epilepsy we find great talent and civic worth, and even genius. The very fact that a person would come and consult the physician as to whether he should marry or not is a sign of civic worth and high moral character, and in giving advice we should be guided by a consideration of the stock into which he or she proposes to marry. If there is a neuropathic tendency in that stock, marriage into it should be discountenanced, for I shall show you that the chances of insane offspring arising are much greater when there is a dual neuropathic inheritance. Let me illustrate my remarks by two pedigrees: one is that of a man of genius and remarkable mental stability with a bad collateral heredity

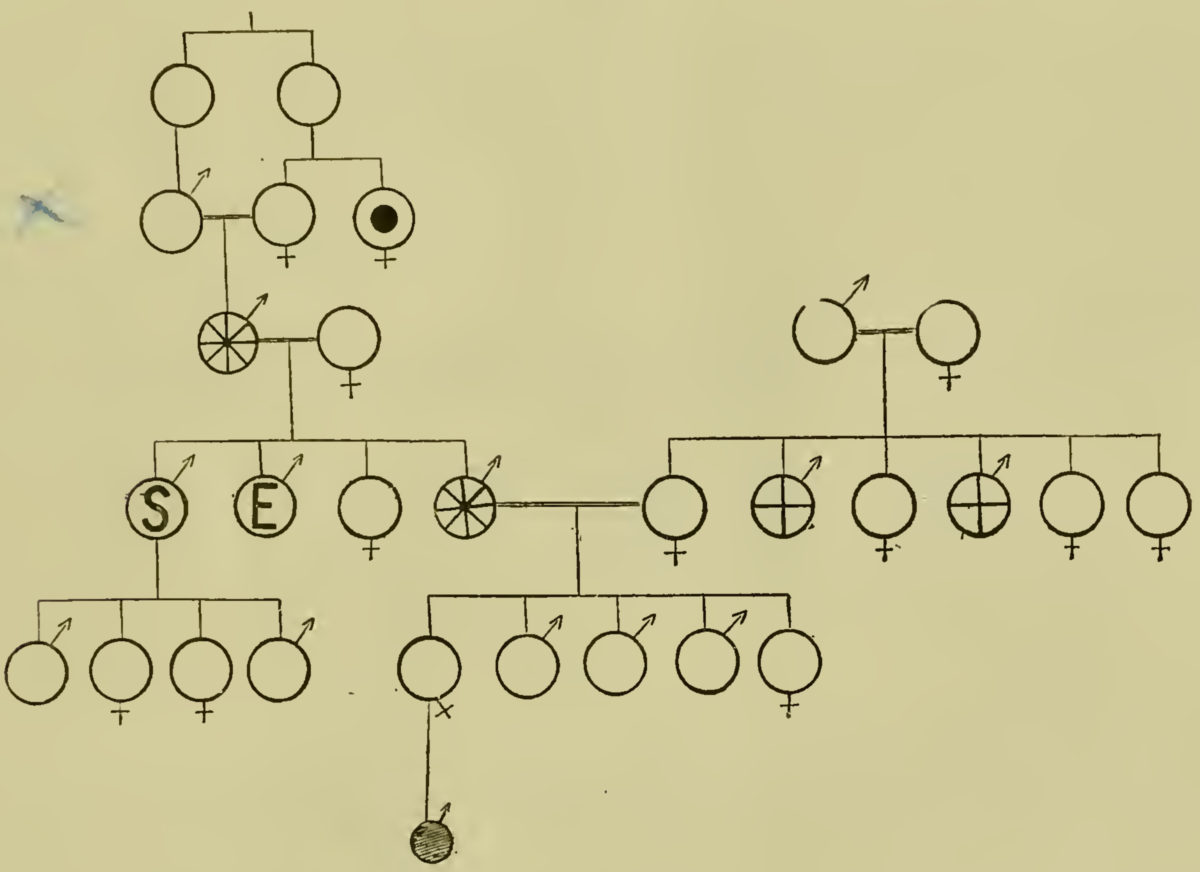


Fig. 10.—A pedigree illustrating the marriage of first cousins. A genius was the result; he married a healthy woman, and their family consisted of an eldest son, a suicide, a second son an epileptic, a daughter, healthy, unmarried, and a son, a genius. This man was a genius, but had an extremely well-balanced mind; all his five children are healthy in spite of collateral inheritance on both sides. *Circles with black centre.* Physically unsound. *Circles in quadrants.* Alcoholism. *Circles in octants.* Genius.

(Fig. 10); the other is that in which pauperism, epilepsy, insanity, tuberculosis and blindness in successive generations occur (Fig. 11). It would have been a national calamity had the former not been allowed to propagate; to cut off the lines of propagation in the latter would have been a national benefit. The popular expression, "he comes from a good stock, or a bad stock," is the result of experience, and quite scientific according to the laws of ancestral inheritance, yet now and then even from an apparently unknown or even bad stock a great man arises. Are we to say that because a parent is insane that therefore the children must necessarily be insane or useless to the race? God forbid!

The Investigation of Pedigrees.

An important point in any scientific investigation is, not to *try* and prove something; that is to avoid any propagandist tendency. The question of alcohol and insanity is an illustration in point. The Council of Fifty in Massachusetts investigated the number of patients admitted to asylums in which there was an alcoholic history; it was then suggested that they might investigate the number of total abstainers; it was found that they were as numerous. The scientific way to approach this question is to carefully investigate the pedigrees of patients admitted, *selected, not* because they show a large number of members of the ancestral stocks as being degenerate, or insane, *but selected* because a complete family history for

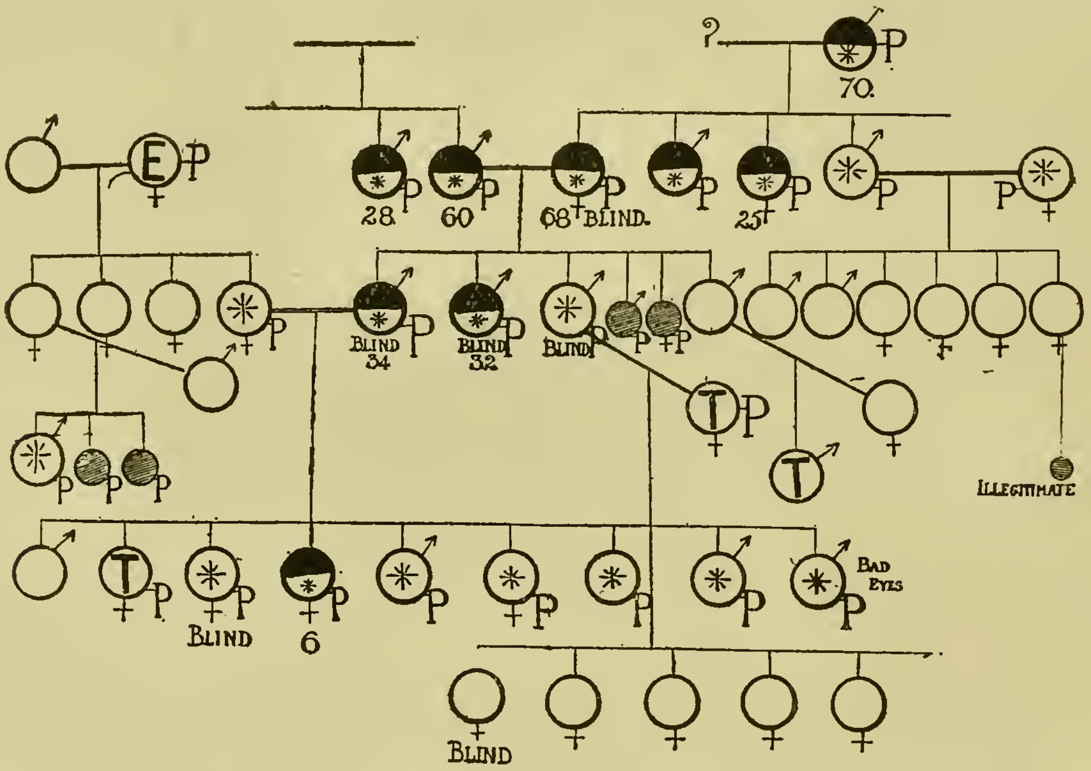


Fig. 11.—Pedigree showing pauperism, insanity, and blindness in four generations (Lidbetter). *Half-black circles.* Insanity. P*. Pauperism. E. Epilepsy. T. Tuberculosis. Figures denote age at time of attack of insanity.

three generations can be obtained. This has been most successfully done by Dr. Hill Wilson White, formerly at the Manor Asylum. The pedigrees he has obtained show conclusively that we must judge the right of a patient to propagate who has had an attack of insanity by a full consideration of his pedigree. The following are a few of a large number of instructive pedigrees that have been collected.

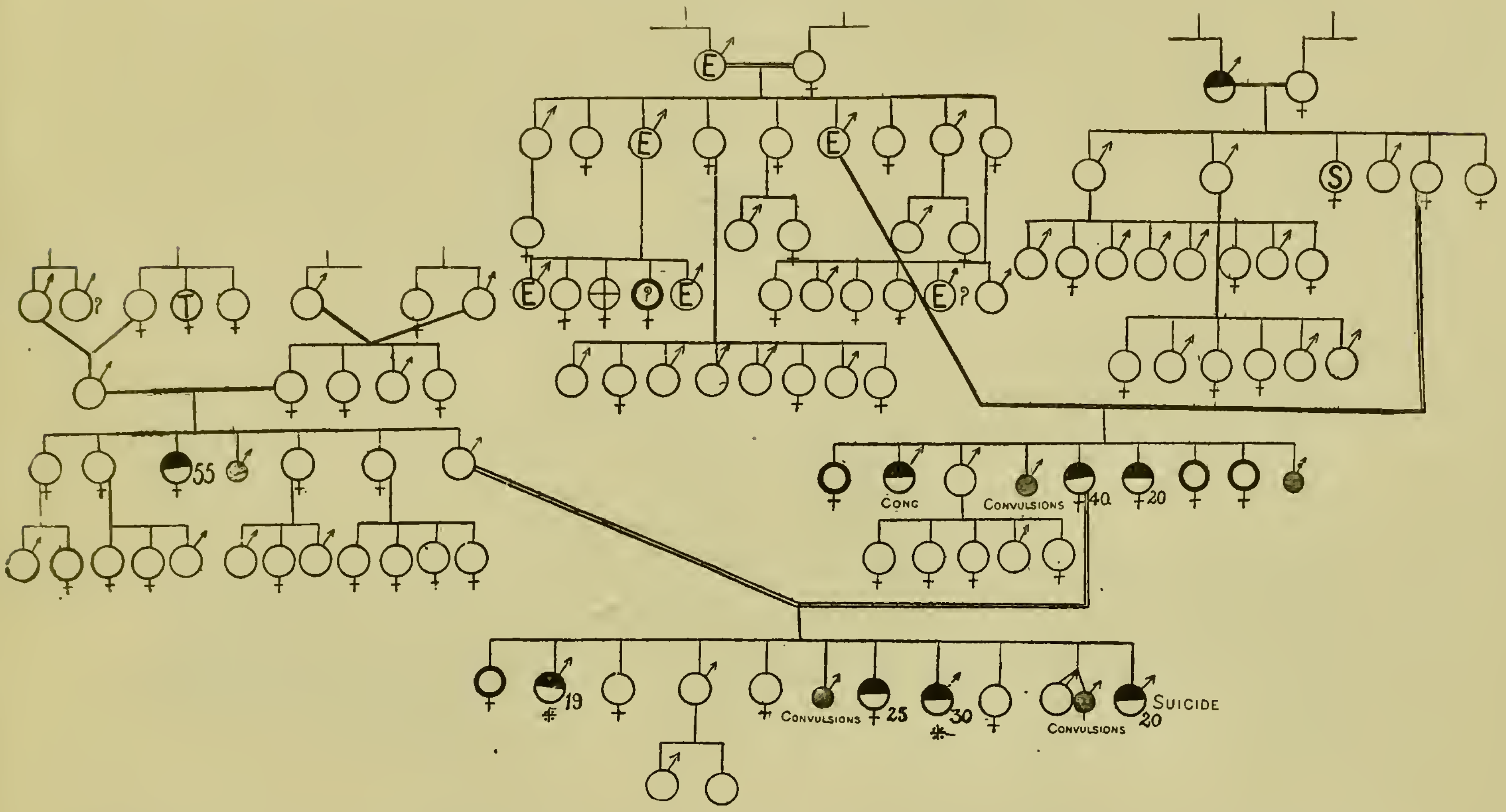


Fig. 12.—A very comprehensive and interesting pedigree obtained for me by Dr. Wilson White, showing the result of marriage of a nearly sound stock in which the temperament was, generally speaking, of the sanguine type; there was only one member insane at fifty-five; she was unmarried; her four sisters, who were all married, had some healthy, grown-up children. The brother himself, perfectly sane and healthy, married a woman descended from stocks in one of which there were many members suffering with epilepsy (e); indeed, her father and her grandfather suffered with it. On the maternal side there was suicide (s) of an aunt and insanity of a grandfather; most of the members of this stock were of a melancholy, brooding temperament. The result of the mating of these two neuropathic stocks is shown. There were nine children, of which three, marked with deep, black-rimmed circles, suffered with some form of neurosis, a male congenital imbecile, a healthy male who has five healthy children, a child who died in early life of convulsions, the patient's mother who became insane at the age of forty, a female who became insane at the age of twenty; two females also suffered with some form of neurosis; lastly, a male who died in early infancy. The next generation shows the result of mating this unsound stock with an almost healthy, sound stock. There are not as many unsound members as in the last generation, and we observe that the four members that became insane at nineteen, twenty-five, thirty, and twenty all had their first attack at a much earlier age than their mother; one of these committed suicide and two were found dead. This pedigree illustrates well the signal tendency to the occurrence of antedating. The sound members of the stock apparently inherited their temperament from the father's side, and the one member that is married has quite healthy children; this looks as if the unsound elements of this degenerate stock had been cleared out by segregation of the unsound germinal determinants, causing intensification of the disease and occurrence of the onset at an early age, thus preventing propagation.

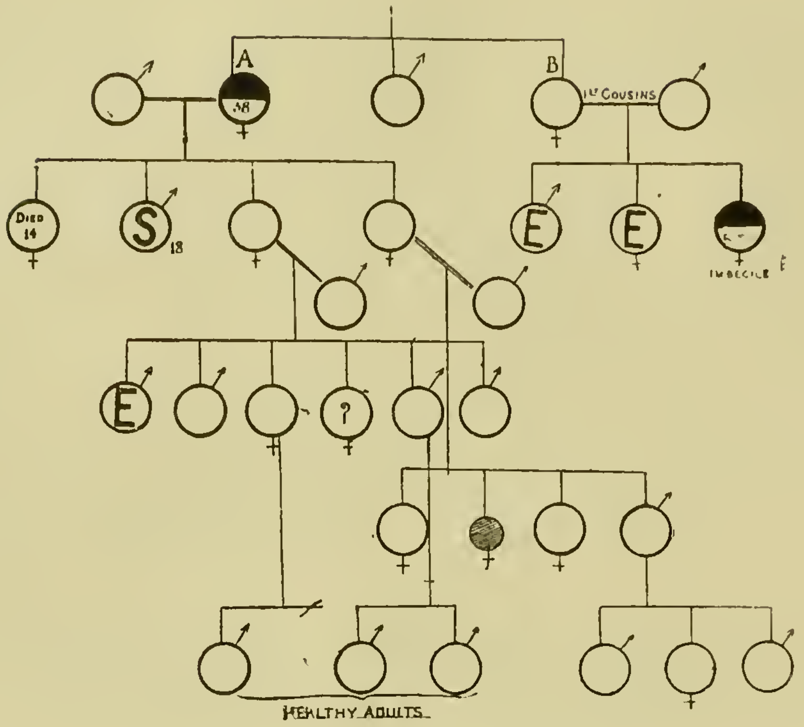


Fig. 13.—This pedigree shows the result of marriage of first cousins, in both of whom there was a latent neuropathic taint. The family consisted of three individuals, two sisters, A and B, and an elder brother, who was married but had no family. B married a first cousin, and although neither of them were insane nor epileptic, yet they had two children epileptic and one a congenital imbecile; this terminated the stock on that side. That there was latent insanity was shown by the result of the marriage and the fact that a sister became insane. A, however, married into a healthy virile stock; she became insane at thirty-eight. Although living many years after she never recovered; the exciting cause was the death of a son by suicide (s) at eighteen. There were two daughters who became mothers of families the eldest son of one suffered with a masked epilepsy, but no other evidence of neuropathy was shown in this generation. The taint seems to have disappeared, inasmuch as there are healthy, grown-up members of the fourth generation.

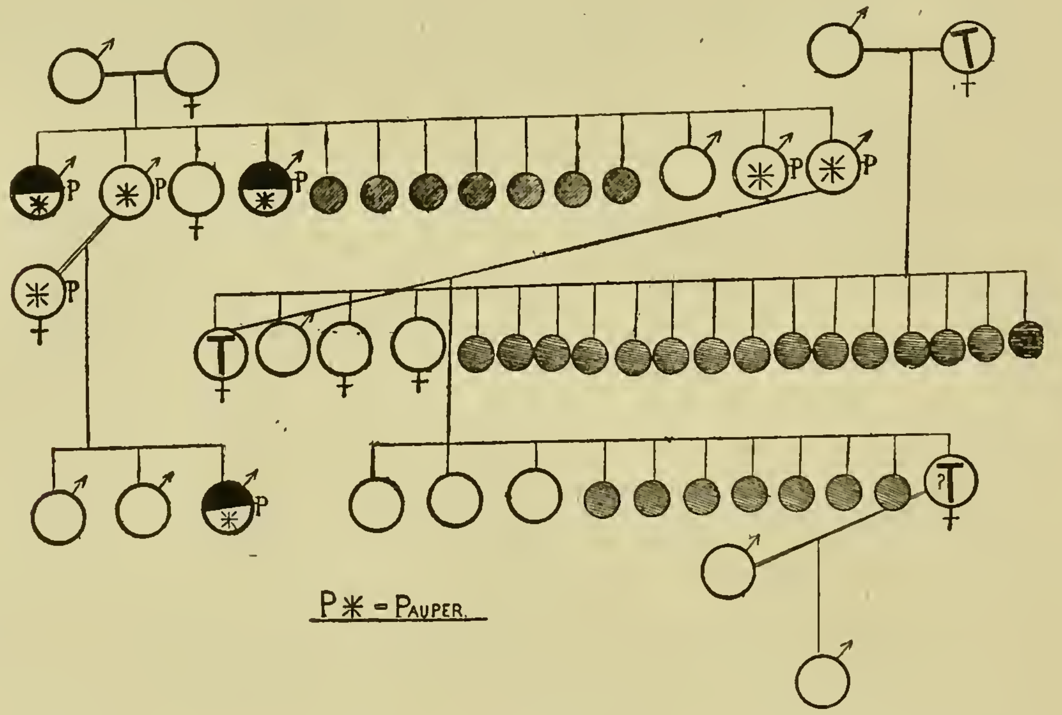


Fig. 14.—A pedigree showing pauperism, fecundity, insanity, and infant mortality. Shaded circles indicate infants dying in early life, half black circles insanity.

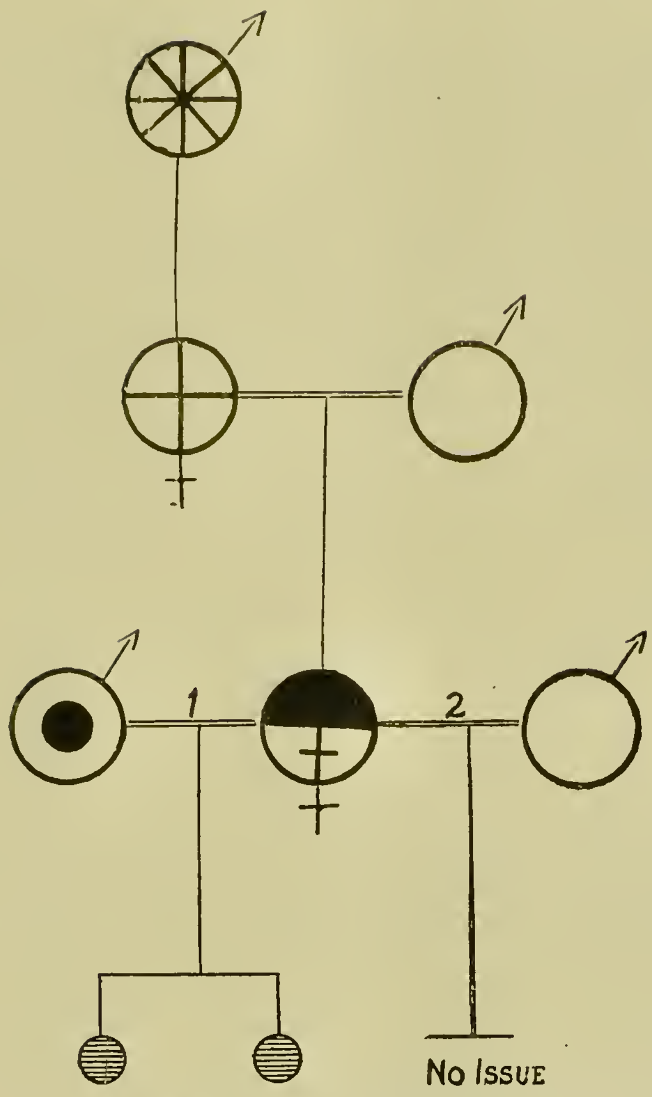


FIG. 15.—The ending of a degenerate stock is illustrated in this pedigree. A very distinguished man had a dissolute daughter, drunken and immoral (figure with a cross); she had a daughter who behaved in a similar manner, was married twice, then became insane; by her first husband she had two children, born dead; by her second husband no issue.

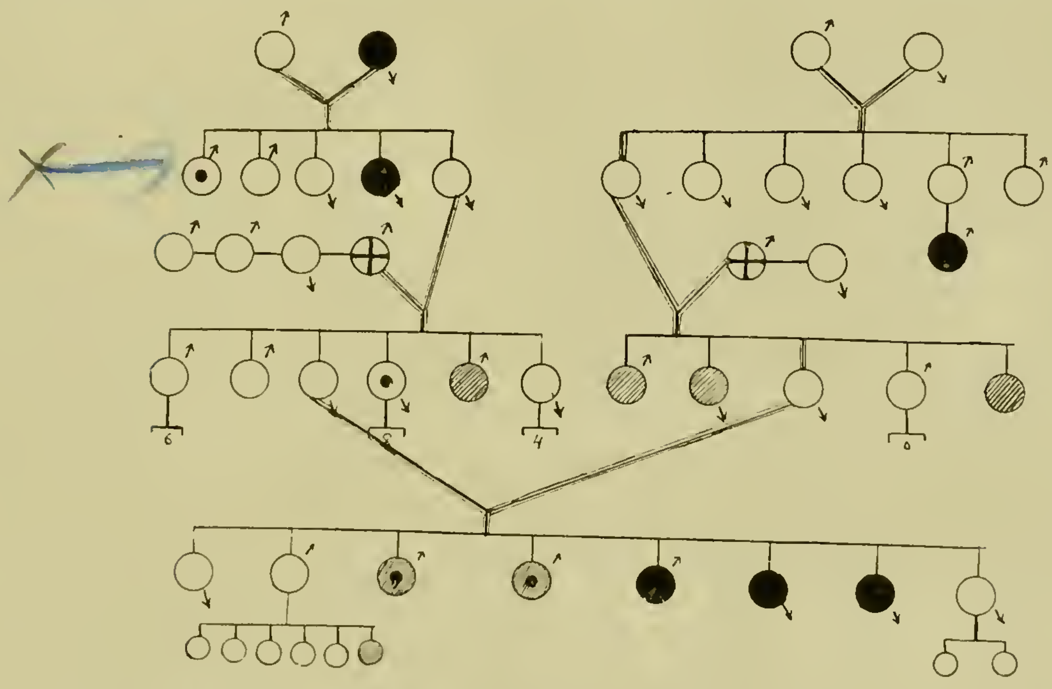


FIG. 16.—This pedigree is instructive as it apparently shows the mending of a degenerate stock. The two eldest children and the youngest have probably escaped the insane inheritance, but we cannot be sure that their children may not be affected especially if either of them have married into a neuropathic stock. The two sisters and brother were admitted with primary dementia of adolescence and are never likely to recover. Both the parents were total abstainers, but it will be observed that in each case the father was a drunkard and on the other side there was insanity. *Full black circles.* Insanity. *Circles in quadrants.* Alcoholism. *Circles with black centre.* Physically unsound. Shaded circles denote death of individual.

p. 39

Now I will pass from this very important study of pedigrees to statistics based upon data afforded by these 3118 cases of relatives which have been indexed.

Analysis of 3118 *Related Cases* (*Instances of two of a Family Insane*).

	Pairs.	Cases.
Mother and daughter	157	314
Mother and son	96	192
Father and daughter	103	206
Father and son	78	156
Brothers and sisters	212	424
Two sisters	211	422
Two brothers	140	280
Husband and wife	69	138
Offspring and grandparents	24	48
Other relationships, collaterals, etc.	186	372
Total	1276	2552
142 instances of 3 of a family insane		426
24 ,, ,, 4 ,, ,,		96
5 ,, ,, 5 ,, ,,		25
2 ,, ,, 6 ,, ,,		12
1 instance of 7 ,, ,,		7
Total		3188

Total—3118 cases made up from 1450 families.

They show the following facts :

(1) In the insane offspring of insane parents daughters are much more numerous than sons.

(2) Amongst insane members of the same family (brothers and sisters) sisters are more numerous than brothers.

This fact may be correlated with the fact that more women are in asylums than men. About one half of the people in the London asylums at the present time have, according to an admirably lucid report of the Clerk to the Asylums Committee, been resident more than ten years. The silting up in the London asylums at the rate of 125–200 per annum is largely due to women. There are several reasons for this: general paralysis, which is a fatal disease, is three times more frequent in men than in women ; the recoveries in women do not bear the same proportion as in men. Now, why should women be more liable to become insane than men? I will briefly summarise the causes which, in my opinion, are operative:

The physiological emergencies connected with reproduction, *i.e.* the menstrual periods, child-bearing, and the cessation of the period of reproduction, the climacterium; moreover, there is a more unstable mental equilibrium in women. I would also add as an important, and perhaps the only *cause* in many instances—the enforced suppression by modern social conditions of the reproductive functions and the maternal instincts in women of an emotional temperament and mental instability.

ANTICIPATION OR ANTEDATING.

Dr. Maudsley has observed that Nature tends to mend or end a degenerate stock. Now, how could Nature best end or mend a degenerate stock? By segregating in a relatively few germs all the unsound elements, leaving the others free—as it were a crystallisation out of the diseased elements. What would this do? you may ask. Well, it would make certain of the offspring so weak by intensifying the disease and bringing it on at an earlier age that they would, if left to Nature's process of elimination, be killed off early, or unfitted for propagation by being brought into the asylums in adolescence. This was termed by Darwin "antedating" or "anticipation," and I have found that there is a signal tendency in the insane offspring of insane parents for the insanity to occur at an earlier age and in a more intense form in a large proportion of cases; for the form of insanity is usually either congenital imbecility or the primary dementia of adolescence, which generally is an incurable disease. This is statistically shown in the figures (p. 28) regarding the age at the time of first attack in the insane offspring of insane parents. You will observe that nearly 50 per cent. of these insane offspring had their first attack of insanity at or before the age of twenty-five years, and whereas in the case of the insane parents advancing age apparently brings greater liability to insanity, in the case of the offspring, with advancing age the liability to insanity tends rapidly to diminish. Now, besides the fact that this shows Nature's method of eliminating unsound elements of a stock, it has another important bearing, for it shows that after twenty-five there is a greatly decreasing liability of the offspring of insane parents to become insane, and therefore in the question of advising marriage of the offspring of an insane parent this is of great importance. Sir Geo. Savage recently said that this statistical proof of mine entirely accorded with his own experiences, and that if an individual who had such an hereditary history had passed twenty-five and never previously shown any signs he would probably be free, and he would offer no objection to marriage.

ANTICIPATION OR ANTEDATING IN RELATION TO THE HEREDITARY TRANSMISSION OF DISEASE.

I am indebted to Mr. Nettleship, who has done so much to advance our knowledge of the hereditary transmission of disease, for calling my attention to this law. He has defined anticipation in hereditary disease as a manifestation of the morbid change at an earlier age either in members of each succeeding generation as a whole, or in successively born children of one parentage.

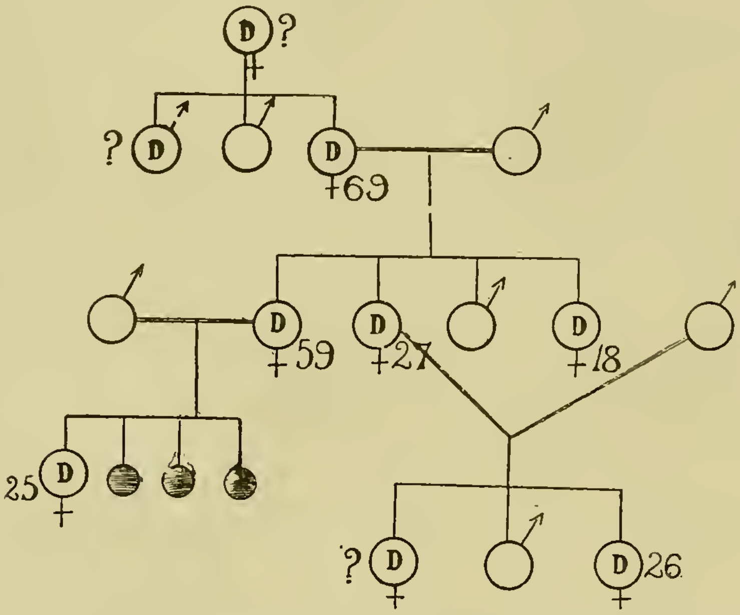


FIG. 17.—Pedigree of diabetes (after Nettleship). Figures denote age at time of onset of disease.

Darwin, in his 'Animals and Plants under Domestication,' refers to anticipation thus: "There is a strong tendency to inheritance to disease at corresponding periods of life. When the rule fails, the disease is apt to come on earlier in the child than in the parent, exceptions in the other direction being much rarer."

Lucas alludes to several cases of inherited disease coming on at an earlier period. Bowman remarks that this frequently occurs with cataract.

Nettleship gives some interesting facts and pedigrees of anticipation in diabetes (Fig. 17) and glaucoma (Fig. 18), and he has collected a number of pedigrees in which the age at death is stated in the diabetic children of diabetic parents. Thirteen diabetic children of diabetic parents died at the average age of twenty-five; ten diabetic parents of the above offspring died of diabetes at the average age of fifty-one. Bence Jones, Pavy, and Naunyn recite cases illustrating antedating in hereditary transmission of this disease. Dr. Albert Gray has furnished me with three pedigrees of otosclerosis showing antedating. Nettleship, in his 'Bowman Lecture,' remarks that anticipation appears to occur in phthisis, and he refers to Pollock's 'Medical Handbook of Life Assurance,' fourth edition, 1895, and Karl Pearson, 'A First Study of the Statistics of Pulmonary Tuberculosis,' 1907.

From the study of pedigrees I had, early in my investigations on heredity, often observed that there was a general tendency for insanity not to proceed beyond three generations. There is frequently either an apparent regression to the normal type or the stock dies out. Not infrequently the stock dies out by the inborn tendency to insanity manifesting itself in the form of congenital imbecility, or in the insanity of adolescence. Such patients, especially paupers, are prone to die of tuberculosis; thus rotten twigs are continually dropping off the tree of life. Morel, in 1859, pointed out that progressive uninterrupted transmission leads finally to special degenerative forms, to imbecility and idiocy, and with the diminished capability of propagation of the latter kind the stock therefore gradually becomes extinct.

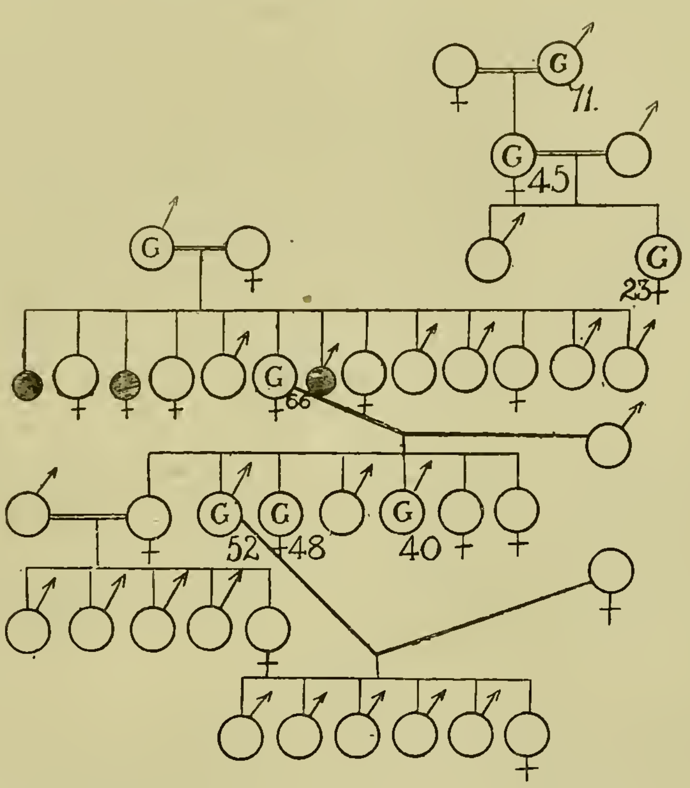


FIG. 18.—Pedigree of glaucoma (after Nettleship). Figures denote age at time of onset of disease.

Antedating and intensification of heritable disease, or predisposition to disease, would not only lead to diminished vital resistance to poisons or germs of disease such as alcohol and tuberculosis, but also, owing to lack of physical and mental ability to obtain the necessaries of life, vital resistance is still further diminished, so that the tendency is for the unsound members of the third or fourth generation of a mentally degenerate stock to die at a comparatively early age of some intercurrent disease, especially tuberculosis, and thus propagation is prevented. Again, the earlier the disease or defect appears, and the more intense its form, the less likely is marriage to occur and offspring to be born; moreover, obvious inherited disease or congenital defect, such as hare-lip, cleft palate, and predisposition by inheritance to insanity or epilepsy, interfere with marriage and parentage among the better classes; unfortunately it does not interfere with marriage or mating and parentage among the lowest, most fertile, least desirable classes of the population.

Sterility often accompanies marked mental deficiency, but there is no limit to the fertility of the higher-grade imbecile; in fact, the poorer the stock in mental and physical power and civic worth, the more prolific it is. In our cities and large towns venereal disease sterilises very soon the great bulk of women who lead immoral lives; this is not so in the country districts, where a weak-minded woman may have a large number of illegitimate children. A great source in my opinion of racial degeneracy is the prolific higher-grade imbecile.

Before considering the evidence which I have obtained of this law of anticipation in relation to neuropathic and psychopathic degeneration of stocks I would like to call your attention to some interesting observations on this subject by Nettleship. He says:

> "Anticipation or antedating of onset or of completion in a family might be taken to show the transmission of an acquired character. But it probably may be explained as well, or better, by assuming that certain defects, taints or vices of the system, say of the blood, are not only hereditary in the true or germinal sense, but able to produce toxic agents in the embryo, which have an evil influence on all its cells, and thus so lower their power of resistance that the innate hereditary factor has freer play, and is likely to manifest itself earlier. There may also be toxic agents in the embryo that have no relation to the hereditary vice, but yet may, and probably do, act in a similar manner as excitants of the disease."

I cannot here discuss the chromosome theory, but it is generally assumed that there is a particulate inheritance derived from the nuclear substance of the male and female germ-cell in the fertilised ovum, and that the nuclear substance derived from each parent is equal in amount (*vide* Fig. 1). This seems to be proved by the facts observed concerning the reduction of the chromosomes in the process of maturation of the male and female germ-cells. Weismann adopted the chromosome theory of germinal determinants, and Nettleship has modified a diagram of a scheme of transmission by Ziegler.

Certainly this idea of the scheme explains certain facts which have been observed in the pedigrees I have shown; it shows why the offspring of parents derived from two tainted ancestral stocks are more likely to suffer with an intense form of the disease; it shows also why more of the offspring are liable to be affected, and it shows why a certain proportion of the offspring may escape entirely; but according to the hypothesis thus advanced it does not explain why only relatively few of the offspring are tainted as compared with the numbers born, even though there be convergent neuropathic inheritance, that is, the germinal determinants of both parents may be largely tainted and yet fewer offspring are affected by the disease than would be expected. In neuroses and psychoses it is not a disease that is transmitted but a predisposition or tendency, and some other factor than the inborn is required to produce the disease. If we ask ourselves the question, How could Nature best purify an unsound stock? the

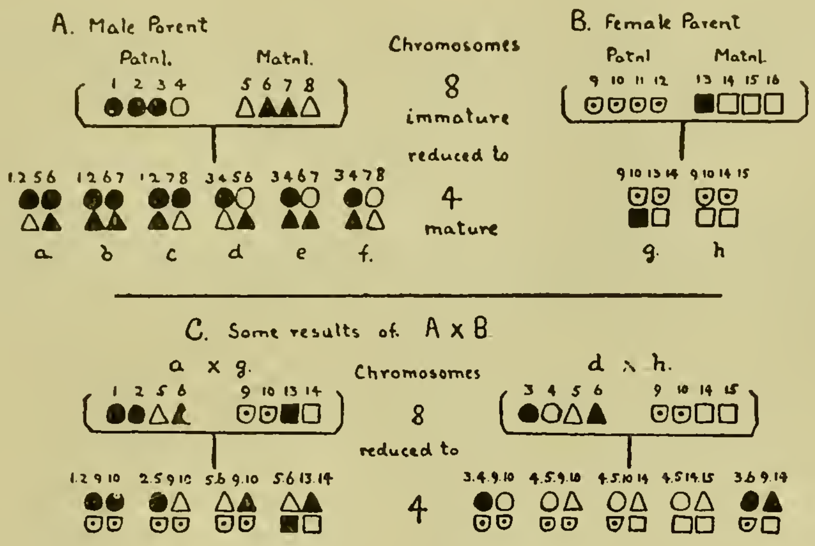


FIG. 19.

A represents the male parent; his immature germ-cells have derived their chromosomes, germinal determinants or representative particles (Galton) from his father and mother, and they are respectively represented by different figures. The eight germ-mature chromosomes are reduced to four during maturation, two from each parent; the figures *a*-*f* indicate the combination of two maternal with two paternal, all diseased, but in different degrees and modes. B represents the female parent, in which there is an inherited taint, but only to a slight degree, coming from the maternal side; in the mature germ-cells only one, containing number 13, will be tainted. C shows some of the results which may arise from the conjugation of A × B.

Assuming the intensity of inheritance is constant for each chromosome or other unit of germ-plasm, but to vary with the number of the germinal units tainted, we have as a result of the mating of these two tainted stocks all degrees of manifestation of ancestral characters, from perfect normality to the most profound disease. The more numerous the tainted germinal units the greater will be the chance of the disease appearing in the offspring. On the other hand, the oftener reduction, with its possible random arrangement, has occurred, *i.e.* the greater the number of generations—the less will be the chance of any particular character finding a place in the inheritance (Nettleship).

obvious answer would be to cause coalescence or crystallisation out of the unsound germinal determinants into a few of the offspring, leaving the germ-plasm of the others free. This would not only purify the stock by segregation but by concentration in one or two offspring; it would lead to intensification and anticipation of the disease. The diseased offspring would be unfit for the struggle for existence and propagation. In putting forward this theory of coalescence of similar diseased germinal determinants, I may mention in support of it a statement made by Galton in his great work on natural inheritance. "In the process of transmission by inheritance elements derived from the same ancestor are apt to appear in large groups, just as if they had clung together in the pre-embryonic stage, as perhaps they did."

STATISTICAL DATA RELATING TO INHERITANCE AND INSANITY, ESPECIALLY IN RELATION TO ANTICIPATION.

From an investigation of the age at the time of first attack in 508 pairs of parent and offspring (from the records of 464 insane parents of 500 insane offspring) the following table has been compiled. The figures denote the percentage of cases whose first attack occurred within the given age-periods.

Age-periods.	Father.	Offspring.	Mother.	Offspring.	
Under 20 years . . .	1·4	26·2	0·6	27·8	
20–24 ,, . . .	0·4	18·0	3·4	15·7	Adolescence.
25–29 ,, . . .	1·4	18·0	4·4	18·2	
30–34 ,, . . .	9·6	13·0	7·8	13·4	
35–39 ,, . . .	11·5	7·3	9·2	10·0	
40–44 ,, . . .	9·2	6·4	10·3	5·8	
45–49 ,, . . .	14·3	6·0	12·0	3·7	Involutional period.
50–54 ,, . . .	17·5	0·9	12·3	2·4	
55–59 ,, . . .	13·8	3·7	14·0	1·7	
60–64 ,, . . .	10·1	—	11·6	1·3	
65–69 ,, . . .	5·0	—	8·8	—	
70–74 ,, . . .	4·6	0·4	3·1	—	
75–79 ,, . . .	0·4	—	1·3	—	
80 ,, . . .	0·4	—	0·6	—	

These figures are shown graphically in the following diagram (Fig. 20), the abscissæ representing the age-periods and the ordinates the percentage of cases whose age at the time of first attack falls within the given periods. They clearly show the signal tendency to the occurrence of most of the insanity in the offspring of insane parents at a much earlier age than in the parent; that is to say, antedating or anticipation is the rule.

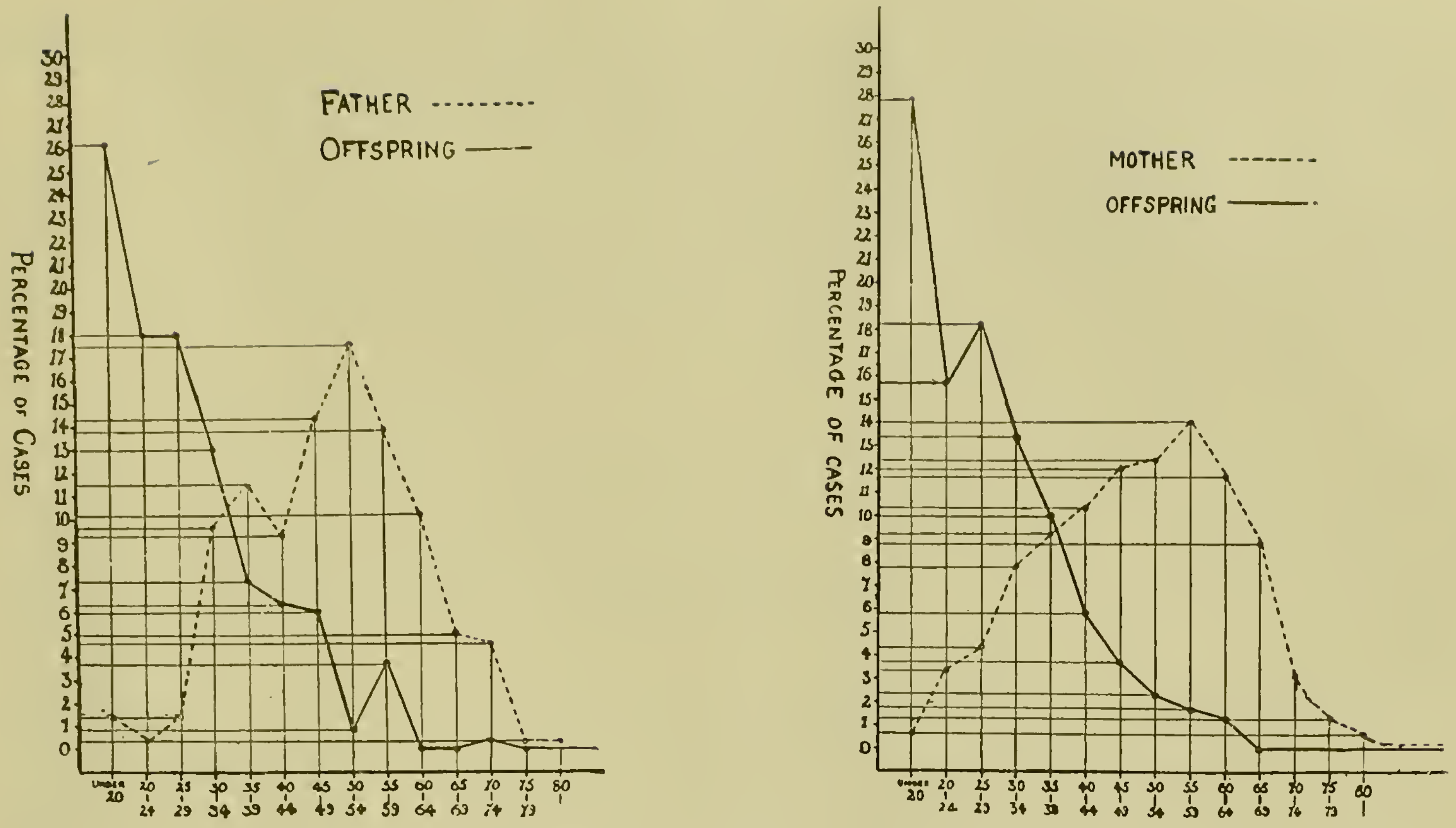


Fig. 20.—A comparison of these two curves show a notable difference in the dotted line curves of the two parents. The curve of the mothers rises steadily and progressively from 20—55. The curve of the fathers does not commence to rise till after 25; there is a small peak at 35—39. This is the period when general paralysis is most likely to occur. But the main difference in the curves of fathers and mothers is due to the incidence of child-bearing which causes the steady rise to the climacterium in the maternal curve.

Investigating the ages at the time of first attack in the insane offspring of insane parents, I find in the following pairs that 239, or 47·8 per cent. out of 500 offspring, had their first attack at or before the age of twenty-five years:

Mother—son	51	out of	118	offspring.
Mother—daughter	81	,,	170	,,
Father—son	45	,,	90	,,
Father—daughter	62	,,	122	,,

Total . . . 239 out of 500 offspring = 47·8 per cent.

The following table shows the average age at the time of first attack in the parent and offspring:

	Parent.	Offspring.
120 pairs mother—daughter . .	49·7 . .	29·3
67 ,, mother—son	50·2 . .	30·7
76 ,, father—daughter . . .	50·1 . .	30·4
51 ,, father—son	51·9 . .	33·1
79 parents, 133 offspring in families with more than two insane . .	47·7 . .	28·7
Total: 393 parents, 427 offspring .	49·7 . .	30·0

In addition there were 71 parents whose average age was 49 years at the time of first attack who were associated with imbecile offspring.

Lastly, I find that in 299, or 58·8 per cent. of the 508 pairs of insane parent and offspring, the first attack in the offspring occurred at an age twenty or more years earlier than in the parent; of these 299 instances 73 of the offspring were imbeciles.

COLLATERAL HEREDITY.

When collateral heredity is studied the same signal tendency to occurrence of anticipation or antedating is shown, as the following tables and curves prove.

The subjoined table is compiled from 193 pairs of uncles and aunts with nieces and nephews in which only collateral heredity is manifested, and 231 pairs of uncles and aunts with nieces or nephews, in which are included those instances where one or both parents of the nieces and nephews are also insane. The figures denote the percentage of cases whose first attack occurred within the given age-periods.

Age-periods.	Collateral only.		Collateral and direct.		
	Uncle or aunt.	Niece or nephew.	Uncle or aunt.	Niece or nephew.	
Under 20 years . . .	5·2	20·7	5·2	25·5	
20–24 ,, . . .	3·1	19·2	3·4	17·7	Adolescence.
25–29 ,, . . .	6·2	18·6	7·8	19·0	
30–34 ,, . . .	12·9	17·1	14·3	15·1	
35–39 ,, . . .	11·9	12·4	12·1	11·2	
40–44 ,, . . .	11·3	5·7	10·4	4·3	
45–49 ,, . . .	12·4	2·1	12·1	2·6	Involutional period.
50–54 ,, . . .	14·5	2·1	12·1	1·7	
55–59 ,, . . .	7·7	1·5	8·6	2·1	
60–64 ,, . . .	8·8	—	8·2	—	
65–69 ,, . . .	1·5	0·5	1·7	0·4	
70–74 ,, . . .	1·0	—	1·3	—	
75–79 ,, . . .	3·1	—	2·6	—	
80– ,, . . .	—	—	—	—	

These figures are shown graphically in the following diagrams, the abscissæ representing the age-periods and the ordinates the percentage of cases whose age at the time of first attack falls within the given periods (Fig. 21).

Of the insane nieces and nephews of insane uncles and aunts, 103 out of 208, or 49·5 per cent., had their first attack at or before the age of twenty-five years.

Uncle—nephew or niece . .	51	out of	93	
Aunt—nephew or niece . .	52	,,	,, 115	
Total . .	103	,,	,, 208	= 49·5 per cent.

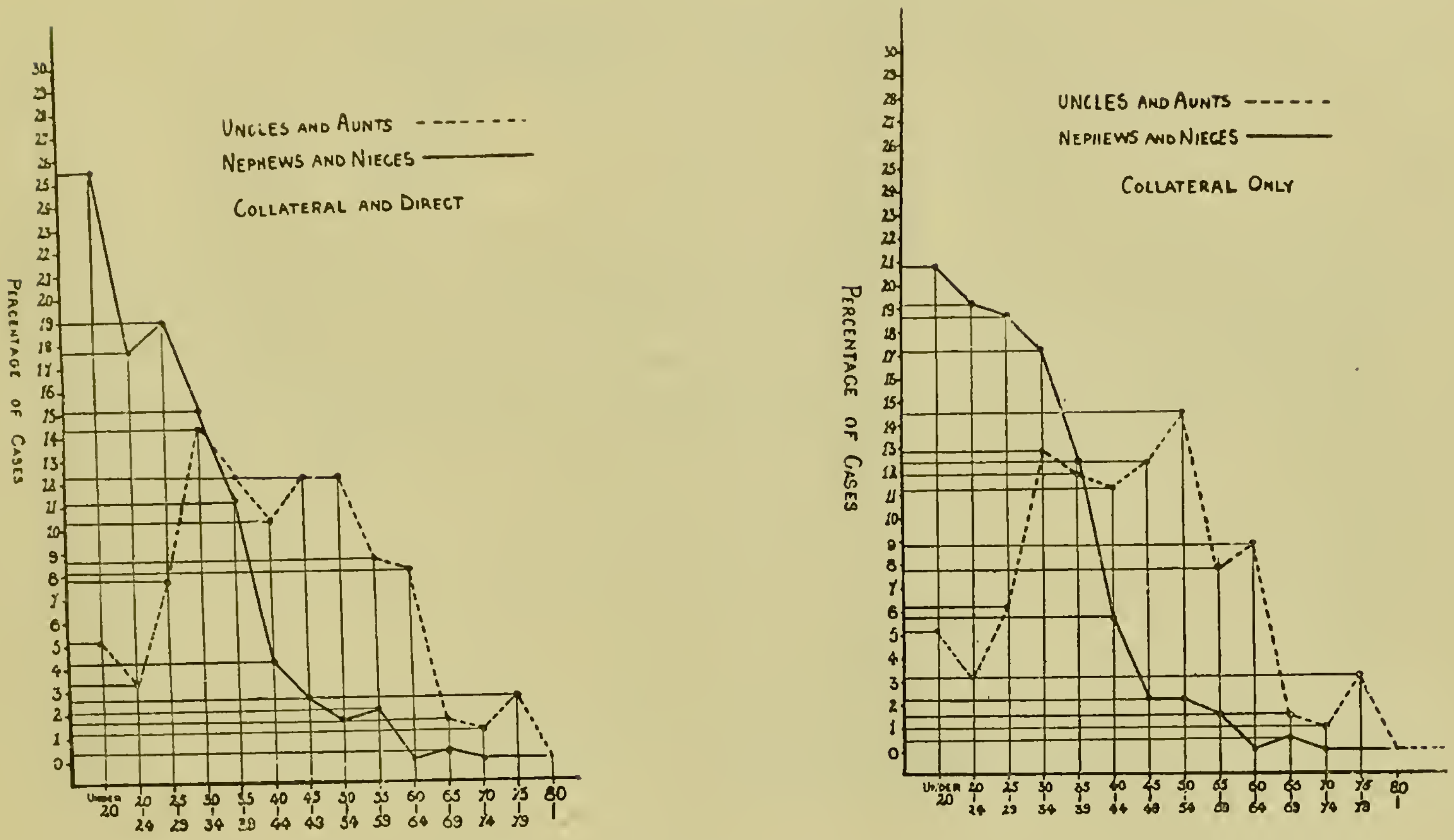


FIG. 21.—A comparison of these two curves show that the tendency to anticipation or antedating is less marked when there is only collateral inheritance; it will be observed that the offspring curve slopes very gradually in comparison with that of parent and offspring, as well as with that of collateral and direct.

SOME FAMILY RECORDS SHOWING ANTICIPATION.

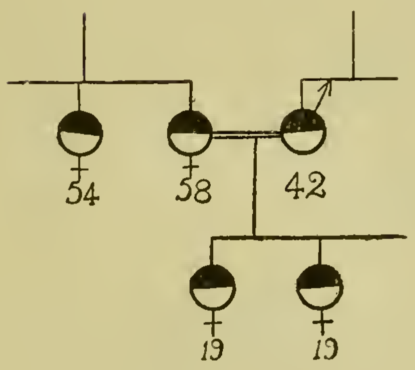


FIG. 22.

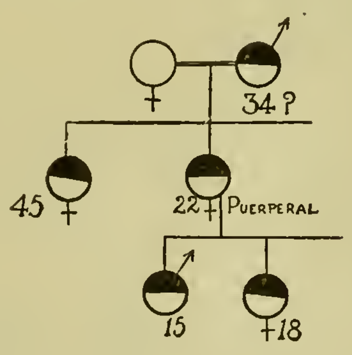


FIG. 23.

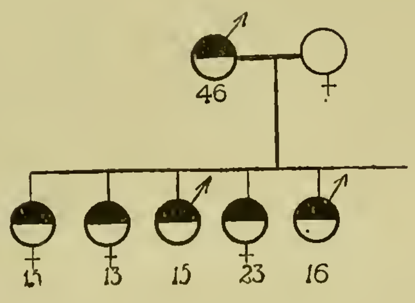


FIG. 24.

FIGS. 22, 23, and 24.—Three pedigrees to illustrate "antedating"; the onset of insanity in the offspring is shown to occur at a much earlier age than in the parents. These pedigrees also illustrate extreme cases of hereditary transmission of the neuropathic taint; as a rule not more than one insane offspring of an insane parent occurs in four or five. The occurrence of insanity in all the children is probably due to the fact that there is a double insane inheritance in all these instances, although it is only shown in one completely, and one partially.

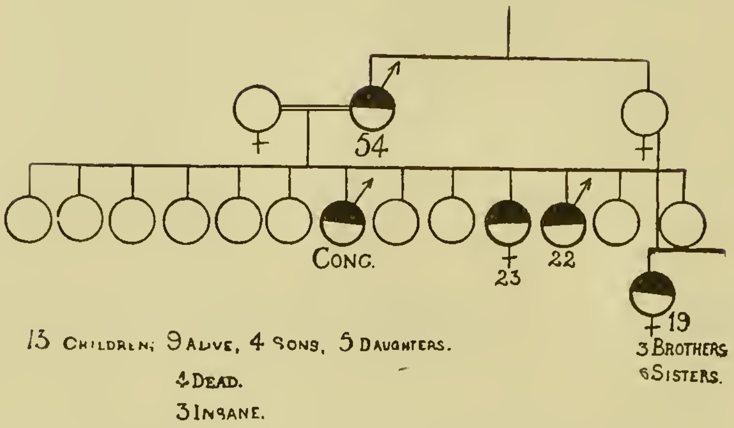


Fig. 25. —A. B—, an alien Jew, aged 54 years, was admitted to an asylum for the first time suffering with involutional melancholia; he has a sister who has not been in an asylum, but, as events turned out, bore the latent seeds of insanity. The man is married to a healthy woman who bore him a large family; the first five are quite healthy, then comes a congenital imbecile epileptic (cong.), then two healthy children, followed by a daughter who becomes insane at twenty-three, then a son insane at twenty-two, and lastly, two children who are up to the present free from any taint. The sister of A. B— is married, and has a family of ten, seven girls and three boys; one of the females was admitted to the asylum at the age of nineteen, and since this pedigree was constructed a brother of hers has been admitted, aged twenty-four. Half-black circles are insane. This pedigree is instructive; it shows direct and collateral heredity; it also shows remarkably well the signal tendency to the occurrence of insanity at an early age in the children of an insane and potentially insane parent.

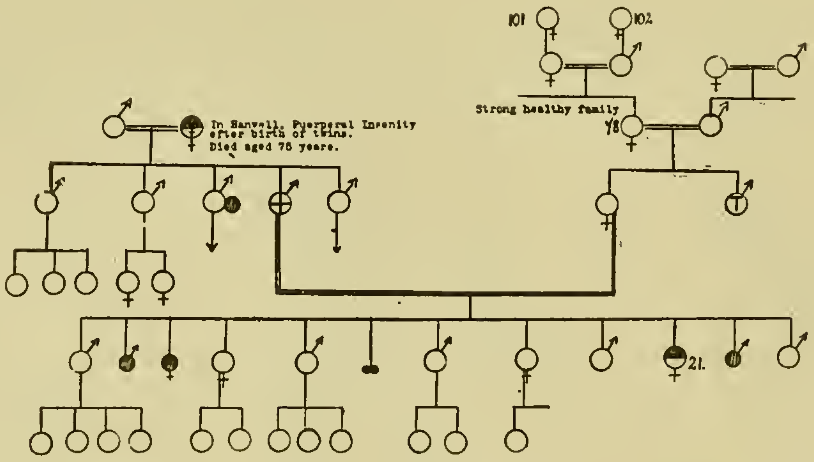


Fig. 26.—In the above pedigree is shown the mating of a female descendant of a strong healthy family with longevity to the drunken son of a drunken mother who also had an attack of puerperal insanity. Of the children from this marriage three died young, *the one affected member became insane in adolescence and has died of tuberculosis in the asylum* (half-black circle), whilst the remainder are apparently healthy, and those who are married have healthy children.

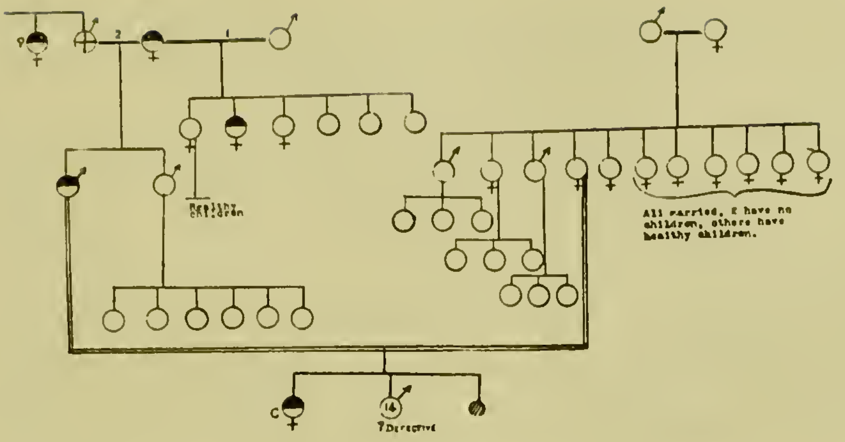

9
2
1
Healthy children
All married, 2 have no children, others have healthy children.
C
14
? Defective

FIG. 27.—This pedigree commences with an insane woman who first marries an apparently healthy man, and of their six children one becomes insane. She next marries a drunkard whose sister is reported to be insane. The result of this marriage was a weak-minded son, who came into the asylum at forty-two years of age, and an apparently normal son, who marries and has healthy children. The insane son married a woman coming from a good stock, with the result that their firstborn daughter is an imbecile, and the second born, a son, is mentally defective.

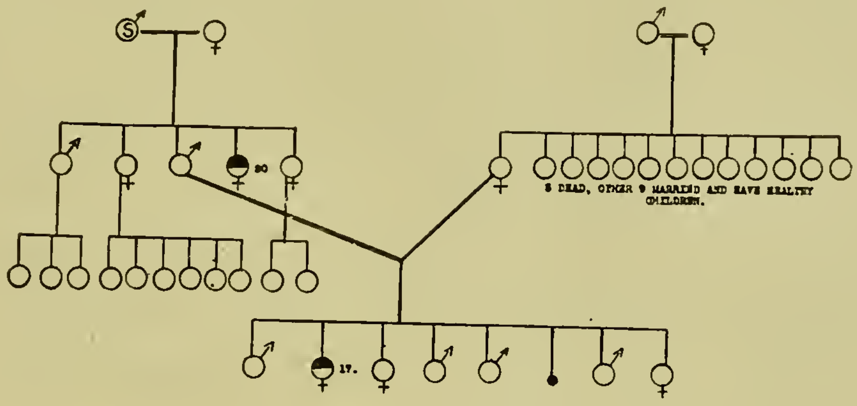


FIG. 28.—This pedigree shows the heredity taint, commencing with suicide (s) in the grandfather and insanity in the next two generations; in each generation the affected member was cut off by adolescent insanity.

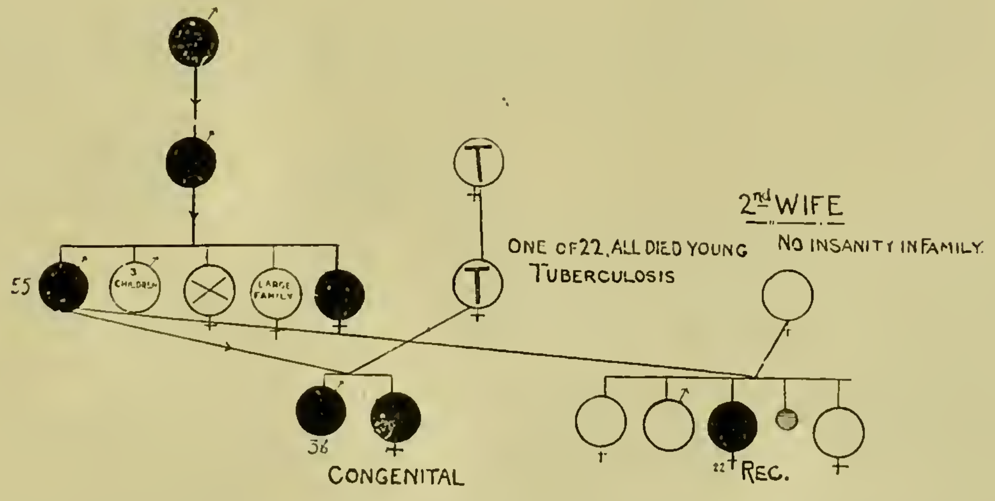


FIG. 29.—Four generations of insanity. By first (tuberculous) wife both children insane (full black circles). "Anticipation" shown. By second healthy wife four children; one suffered with temporary nervous breakdown at twenty-two, recovered after one year. *Circle with* x. Suicide. T. Tuberculosis.

PREVENTION OF PROPAGATION OF THE INSANE IN RELATION TO HEREDITARY TRANSMISSION.

As a leading article in the 'British Medical Journal' of May 11th, 1912, refers to this question of my investigations upon anticipation tending to the ending or mending of a degenerate stock being used as an argument against measures being taken to prevent the propagation of the unfit, I particularly desire to impress upon my audience the fact that I have always laid a great stress upon the necessity of *segregating congenital imbeciles* now that Nature by man's aid does not kill them off as formerly. Moreover, it is highly desirable to follow up those members of the family who are sane and particularly those who are discharged as cured, in order to see whether Nature has really mended that particular degenerate stock.

One of the great arguments advanced for sterilisation has been that recurrent cases of insanity breed lunatics in the intervals of readmissions to the asylums. I have no doubt this is the case, but before Parliament would even consider such a procedure justifiable it would require the strongest and soundest evidence that life segregation or sterilisation would appreciably diminish the numbers of the insane. Single instances are attractive as copy for newspapers, and may serve as object-lessons to the public, but the Legislature will require comprehensive data and statistics. In the following table are some preliminary data relating to this question.

The following figures represent an analysis of the female admissions to three asylums during the year 1911 :

Hanwell	164 female admissions	32 recurrent cases
Claybury	259 ,, ,,	64 ,, ,,
Cane Hill	219 ,, ,,	52 ,, ,,
Total	642 ,, ,,	148 ,, ,,

Further investigating these recurrent cases the following figures are obtained :

	Hanwell.	Claybury.	Cane Hill.
Single	10	23	21
Married, but no children born during lucid intervals. Involutional insanities, etc.	10	25	13
Married, children born during lucid intervals	10	10	12
No history obtainable	2	6	6
Total	32	64	52

Of 642 female admissions, 148 were recurrent cases, of whom 32 (21 per cent.) had children between their respective dates of admission. Dr. Spark has forwarded me a list of 33 cases (18 per cent.) from a total of 185 recurrent female cases examined who had also given birth to children during their lucid intervals.

The inference that can be drawn is that about one fifth of the recurrent cases, or approximately one twentieth of the female admissions, have children after their first attack of insanity, and of 31 such cases examined, 73 children were born after the first attack of insanity in the parent. A number of these cases were puerperal insanity. I am unable to give the exact figures as to the fate of these children, but a good proportion of them died in infancy, and the majority of them would be too young to decide which might become insane.

Recurrent insanity and epilepsy, with which it is closely allied, in relation to hereditary transmission offer one of the most important problems for scientific investigation by complete family histories and construction of pedigrees, and I can conceive no more important work on the relation of heredity to insanity than the following up systematically of the history of children born in the sane intervals of cases admitted several times to the asylums.

From the statistics of relatives a computation has been made of the proportion of offspring who were born after the first attack of insanity in the parent.

The figures are as follows:

Five hundred and ninety pairs of parent and offspring investigated from 529 insane parents with 581 insane offspring.

Mother and daughter	pairs	17	children	born	after	first attack.
Mother and son	,,	9	,,	,,	,,	,,
Father and daughter	,,	11	,,	,,	,,	,,
Father and son	,,	9	,,	,,	,,	,,
Total		46	,,	,,	,,	,,

Forty-six offspring out of 581 were born after the first attack of insanity in the parent, *i. e.* 7·9 per cent.

That is to say in the case of 529 insane parents *the birth of only one twelfth of their* 581 *insane children would have been prevented by sterilisation or life segregation of the parent after the first attack of insanity.*

These figures refer to the offspring which become insane, *but there are a large number of offspring which do not become insane, and these would be cut off if life segregation or sterilisation were adopted.*

SINGLE COMPARED WITH DUAL NEUROPATHIC INHERITANCE.

Every pedigree is a study in itself and occupies a whole book if systematically carried out as regards inheritance of characters, and the classification of the same is a matter of considerable difficulty. We have not enough systematic pedigrees yet to form precise data and conclusions upon, but I may be permitted to refer to indications from the examination of pedigrees of three generations which I have obtained myself and combined with those obtained by Dr. Wilson White and Dr. Daniel. I will divide them into two groups: (1) those with a double pathological inheritance—that is, both ancestral stocks show insanity, feeble-mindedness, drunkenness, epilepsy, suicide, or nervous disease of various kinds, direct or collateral within two generations, and (2) those with a pathological inheritance on one side only:

(1) The analysis of families with a double insane inheritance, represented by insanity, suicide, nervous disease, in both paternal and maternal antecedents, direct or collateral, within two generations:

Eighteen Families examined.

No. of children.	No. died young.	Insane, suicide, nervous disease.	Apparently normal.
116	16	39	61

39 per cent. of the offspring reaching adult age were affected.

(2) The analysis of families in which there was an insane inheritance on one side only.

Ninety Families examined.

No. of children.	No. died young.	Insane, suicide, nervous disease.	Apparently normal.
384	40	33	311

9·6 per cent. of the offspring reaching adult age were affected.

The conclusion which may be drawn is that a child born of a dual neuropathic inheritance stands on an average a chance of being insane four times as great as where only one stock is infected. This, however, applies to the general average and not to individual cases.

THE QUESTION OF SOCIAL SURGERY.

I have brought before you some of the facts regarding insane inheritance, but there is very much yet to be done in the study of heredity before we can draw any conclusions as to which individual with insane inheritance should be allowed the privilege of propagation and which should not. When the three most eminent authorities, Prof. Karl Pearson, Prof. Bateson and Prof. Arthur Thompson, say that we do not know enough about human genetics to advocate sterilisation with a view to the prevention of the propagation of the unfit, and when in America, where it has been practised, the most eminent authorities, *e. g.* Prof. Davenport, urge the necessity of a scientific investigation and not a propaganda, it is well to pause and consider whether it would not be desirable to place the whole matter of the relation of heredity to insanity and epilepsy on a surer and more certain basis than it is, at present, and to educate the public conscience in positive and negative *eugenics*, that is, in encouraging the propagation of the fit and discouraging the propagation of the unfit. What we have to find out is who are the fit and who are the unfit to propagate? A Spanish proverb says, "The worst pig often gets the best acorn," and there are unfit in all classes of society. Can you make one law of this kind for the rich and another for the poor? It might be argued that imbeciles could be sterilised; the answer would be that it would excite the strongest class prejudice if it were only practised on *one class*. Again, it would be justly affirmed that sterilisation would not improve the intelligence and certainly not the moral character of those who were subjected to this operation. Would any of these feeble-minded be less feeble-minded if they were sterilised? Consequently would they be any *more* capable of earning their living or being individually less dangerous to society? I should say, No. They would still be a constant danger to society and thereby entail a heavy expenditure in legal processes and confinement in asylums and prisons. Moreover, if vasectomy, as its advocates so strongly assert, in no way interferes with the sexual desires and passions, will not sterilisation tend to increase prostitution, immorality and sexual vices in both sexes as well as the spread of venereal disease. It is not generally known that sterilisation is carried on by Nature on a gigantic scale in our large cities by venereal disease, but we have to pay a heavy price for it.

Can anything be done by restriction of marriage? In my opinion restriction of marriage should be approached with the greatest caution, for the desire to propagate will remain, and a worse evil would result from restriction by the birth of degenerate and illegitimate children.

It might be argued that there are a certain number of imbeciles who could be allowed all social privileges excepting reproduction; this would be on the ground that they could pick up a living, and sterilisation would in no way interfere with their doing this. The same objections hold as before mentioned, viz. the cry of one law for the rich and another for the poor; again, it would mean the legalisation of an operation that is fraught with many hidden social dangers. I often think that a number of people who are crying out about the monetary burden of supporting the unfit, are themselves not doing their duty to the race. Many have no children, or they restrict the births; moreover, one does not find the numbers in a family increase with the income. When *hereditary health,* as shown by longevity, fertility and mental stability, in a stock is regarded as a greater asset for happiness in the family and the nation than hereditary wealth, then will be the time for the rich and comparatively prosperous to suggest the desirability of sterilisation of the pauper imbecile and insane. For no one supposes that it would be carried out in all classes.

Social Reform in Relation to Insanity.

I have alluded to various proposals which have been made for the prevention of the propagation of the unfit with a view to the prevention of racial degeneracy, but there are other measures to consider, viz. (1) the general improvement of the social conditions of the population in the belief that physical and mental degeneracy are due to remediable causes. Let us take, for example, the relation of alcoholism to insanity. The general opinion of the experts who gave evidence before the Royal Commission on the Feeble-minded was that alcoholism in one or both parents exerts its influence mainly upon the vitality of the children. It is difficult to prove because alcoholism is often combined with syphilis. Again, how far are the effects of alcoholism in the children of drunken parents due to neglect; *indeed, it has been shown that it is very questionable* whether the children of drunken parents, if removed from parental influence and cared for, would show a defective vitality. I will, however, show three pedigrees, which are almost of the nature of an experiment. I am indebted for the first to the labours of Mr. Leeming, who has undertaken to investigate some of the interesting cases.

The social reformer should recognise not only that good material may be spoilt by a bad environment but that it is impossible to make good material out of bad; but mental energy is dependent upon physical fitness, therefore all those social reforms which improve the general health and fitness of the masses may lead to the possibility of the storage of nerve energy, and enable the possessors to utilise that energy in mental operations requiring attention and will-power. Neurasthenia or nervous exhaustion, one of the commonest affections of modern life, is characterised by lack of will-power and attention, and failure of memory. It is caused by excessive using up of energy without adequate replacement, and worry is its principal cause. It is by improving the bodily health that good food, fresh air and sunlight can increase the mental energy, will-power and working power of the masses, for we all recognise that a healthy body

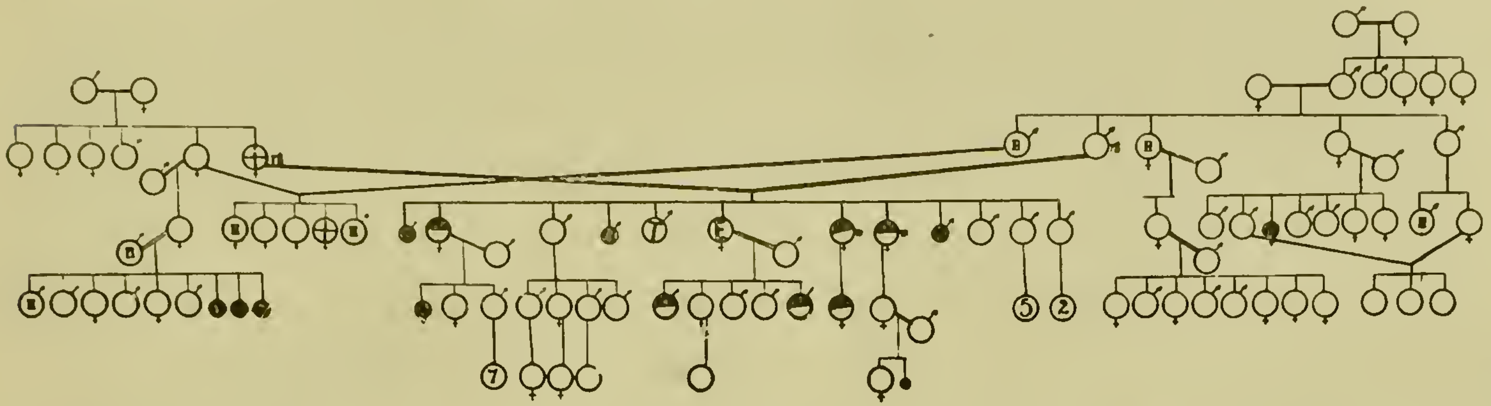
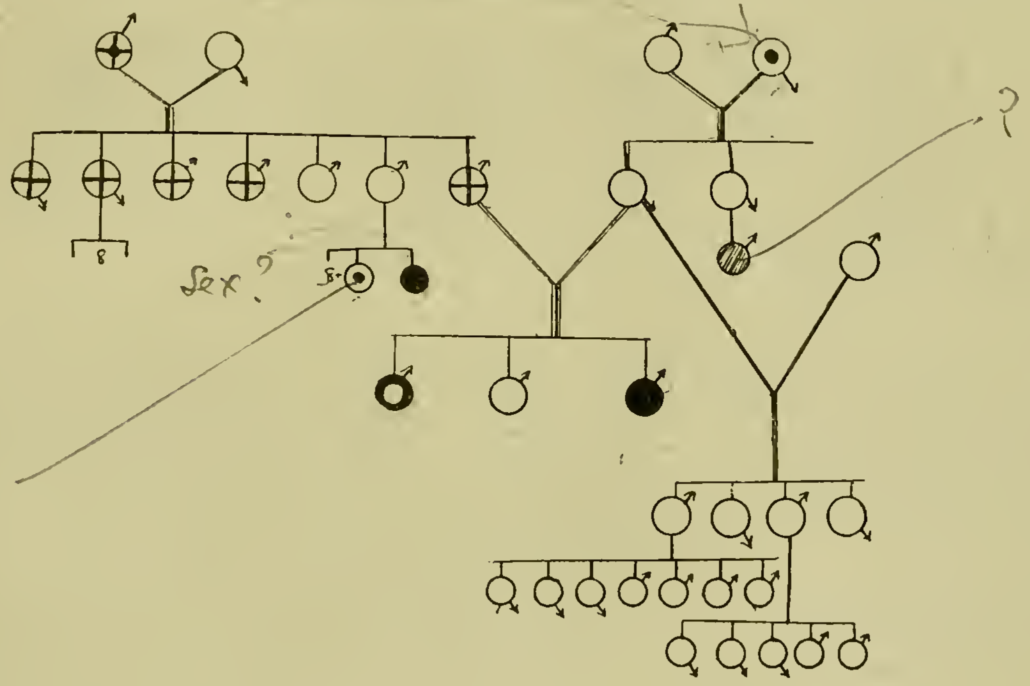


FIG. 30.—This pedigree is of interest in showing the marriage of two brothers with two sisters. In the first instance the male suffered with heart affection, which was transmitted to the offspring. In the second case the female suffered from cirrhosis of the liver and paraplegia, and was probably alcoholic and possibly syphilitic. The result was three insane and one epileptic offspring. From the first insane daughter the issue was apparently unaffected; but from the next daughter, who had masked epilepsy, of five children born, two were insane. The next two insane daughters each gave birth to an illegitimate child by the same father: one of these children became insane at adolescence, whereas the other has married and has an apparently healthy child. H. Denotes heart affection. *Half-black circles.* Insanity.



P. T-O.

p 17, 21, 40, 49.

?

P.

FIG. 31.—Pedigree of a woman with two husbands. By her temperate first husband a healthy stock; by her second, drunken husband only one of the offspring sound. *Circles in quadrants.* Alcoholism. *Full-black circle.* Epilepsy and imbecility. ~~*Circle with dark outline.* Nervous~~ disease.

is necessary for a healthy mind. Children and adults who are the subjects of an acquired mental inertia must be carefully differentiated from those with inborn mental defects, of whom it is computed there are nearly 150,000 in this country at large at the present moment. A Bill has been brought in for segregation of the feeble-minded; it is obviously tentative in its proposals, but it is to be hoped that it will lead soon to an extension of all those measures which will grapple with this vital racial question of propagation of the unfit. Bad raw material must be differentiated by the medical officers of the Education Department, and the earlier in life this is done and the child segregated for life, the better it will be for that individual and for society. Education, sanitation and feeding can do nothing with an inherent bad mental inheritance. Medical officers of the Education Department will, I am sure, have a great opportunity of studying the great social problems of inheritance; likewise the

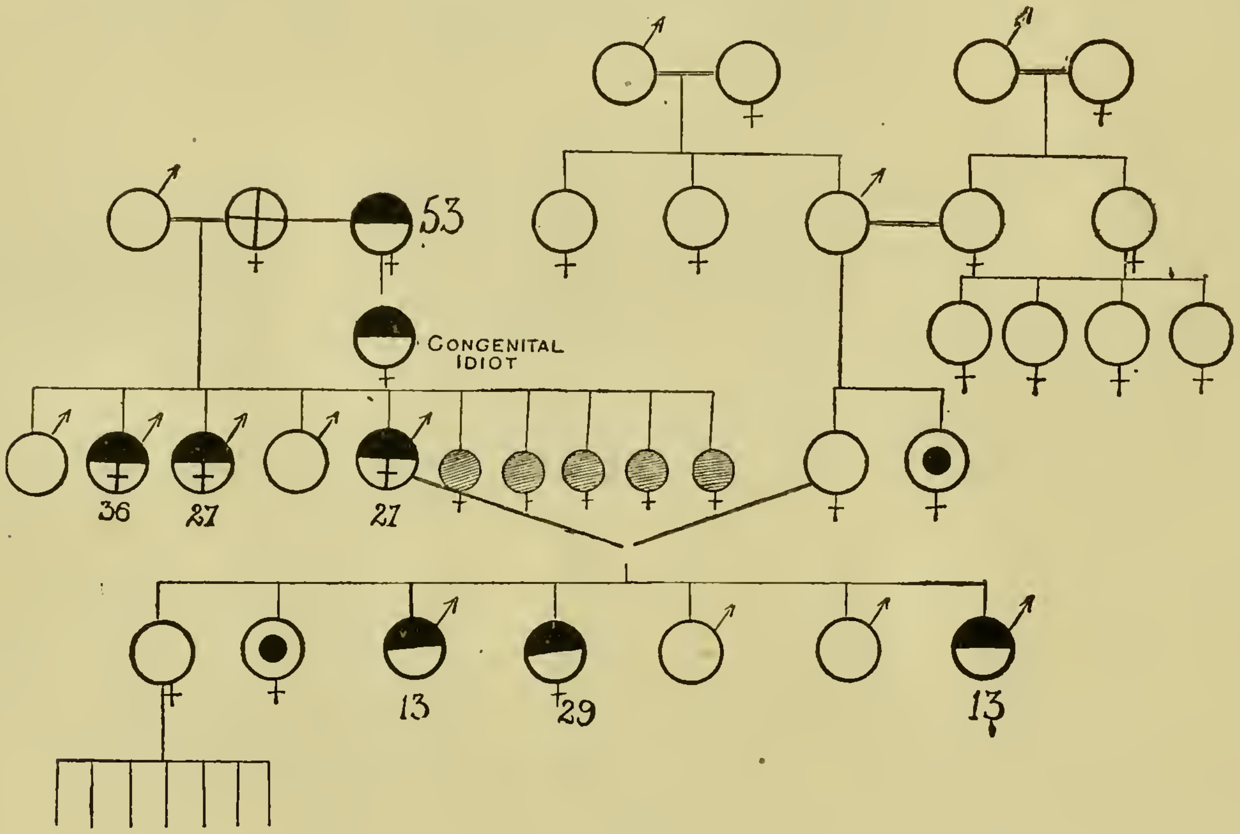


Fig. 32.—A family of drunken and insane people. The figures with half-black circles are insane; the same with the cross indicates drink and insanity; the circles with only a cross indicate excessive drinking. The two stocks show a marked difference; one side the maternal is practically free from any taint; almost every member of the paternal stock is unsound. The degeneracy commenced with a drunken woman whose sister died, aged 53 years, in Colney Hatch Asylum, where she had been twenty years; she had a congenital imbecile daughter in Leavesden. The result of mating a sound individual with a drunken woman with insane predisposition is shown in the members of the family born: a son healthy, then two alcoholic sons who were insane at the ages of thirty-six and twenty-seven, then a healthy son, then another alcoholic son, who also was insane at twenty-seven, finally, five daughters who died in early life, probably through the neglect of a drunken mother, indicated by small, shaded, circular figures. One member of this drunken and insane family married into a healthy sound stock. Seven children were the fruit of this marriage; of these, two sons and a daughter were normal, and three were insane, two of them having become insane at the age of thirteen. The clear circle with a black centre indicates bodily disease. I used to give this pedigree as an instance of drink causing insanity, but after the establishment of the card system of relatives I found the notes of the sister of the drunken grandmother; she was an inmate of Colney Hatch for twenty years. It sometimes happens that the one is taken and the other left, and it would have been a benefit to society if the drunken progenitor of this degenerate stock had been taken.

medical men employed under the Insurance Act; it is to be hoped that they will receive every encouragement from the ruling authorities.

In conclusion, I would add that I can conceive nothing which will be more stimulating to the medical officers of the asylums than the interest the Chairman of the Asylums Committee and the members of the Council have shown in allowing me to give this address, embodying much of the results of their labours, and when a representative body of public men occupying a world-wide reputation throws its weight into any movement, social or scientific, it must move on with increased energy and distinction.

SUMMARY OF ADDRESS AND RECOMMENDATIONS FOR FUTURE INVESTIGATION.

The subject of heredity is a vast one. I have endeavoured firstly to give a brief sketch of two important laws of heredity, and to show how these laws apply to various forms of diseases which are transmissible from one generation to another. The importance of dual inheritance in causing variation, in reinforcing pathological variations, and in regression to the normal average of the race, is dependent upon these fundamental laws, which are applicable to both plants and animals. I have endeavoured to show that chronic poisoning of the blood by syphilis, alcohol and tuberculosis in successive generations may lead to deficient vital energy in the germs and physical and mental degeneracy commencing in the stock. Secondly, I have given a brief account of the work that has been done in the Pathological Laboratory, and on that basis may I, in conclusion, briefly summarise the lines along which the study of heredity in relation to insanity might be most usefully continued with a view to ascertaining the principles which should help us in deciding the class of patient who should be denied the right of propagation, and also how far Nature does strive to mend or end a degenerate stock. Let me consider the last point first.

ANTICIPATION IN RELATION TO ENDING OR MENDING A DEGENERATE STOCK.

I have brought forward conclusive evidence of the signal tendency to the occurrence of insanity in the offspring of insane parents at a much earlier age, viz. twenty years in nearly 60 per cent. Therefore a large proportion of the parents have given birth to their insane offspring before they themselves were insane. Another point, and a very important one, which requires further investigation is this, Does the anticipation which I have shown necessarily either end or mend a degenerate stock? About the proof of the former condition there is no difficulty, for if there are no offspring, or the offspring die in early life, the stock is ended. There is, however, much more difficulty in being sure of the mending of the stock, as there are several questions still unsolved. Nature certainly attempts to mend the degenerate stock by causing the insane offspring of insane parents to suffer with congenital imbecility or primary dementia of adolescence, and thus much is done towards getting rid of unsound members; for these insane offspring would be, or should be, kept in asylums until they die; thus they would never have an opportunity of procreating. What we really want to know is, what is the fate of all the offspring and of the next generation, both of those who are sane and of those who have had an attack of insanity and are discharged as recovered? Do they breed insane or degenerate children? Have the lines of neuropathic inheritance been only partially cut off by Nature? I pointed out in my introductory remarks on the laws of inheritance a great many facts and instances showing that a disease may be latent and reappear in a stock when the conditions of mating or environment are favourable. Therefore we require a collection of pedigrees which will prove conclusively that the offspring who are free from the insane manifestations during adolescence will breed children who will not become insane. This seems possible from the law of ancestral inheritance and Mendelism, but the proof of this must be given. Even if it can only be shown that there is a strong tendency to end or mend a degenerate stock by Nature, we shall learn by a study of these pedigrees how we can materially assist Nature in her effort, *e. g.* supposing it were shown that the discharged *recovered* cases bore the seeds of insanity concealed in their body by later on begetting epileptics and congenital feeble-minded (in its widest sense), or children who later became insane, a clear indication would be afforded that something should be done to prevent this propagation of the unfit.

Secondly.—We want to know what are the inborn characters of children born to parents who suffer with recurrent insanity. Are they more liable to become insane than the offspring of parents suffering with other forms of insanity? Again, what is the proportion of children born in the sane intervals after the first attack, and has the attack of insanity in the parent any time relation to the insanity which subsequently develops in the offspring?

Thirdly.—What types of insanity are especially liable to transmit an insane or neuropathic inheritance? Under what circumstances have epilepsy and anomalous forms of epilepsy a greater tendency to transmit a neuropathic taint? To ascertain this a number of pedigrees of patients should be taken, the selection of cases being made upon the principle of the possibility of obtaining reliable information concerning all the members of the ancestral stocks for three generations or more. A similar collection of pedigrees of normal sane individuals selected in the same manner is required, for such information is essential for comparison. It is only by a long, patient and careful investigation such as I have indicated that we can arrive at a safe conclusion regarding the liability of a particular epileptic or insane patient to transmit an inheritance, the lines of which should be cut off by life segregation or sterilisation. Both Mendelism and the law of ancestral inheritance teach us that we can only attempt to predict the racial value of an individual inheritance by a complete study of what an individual is born with—nature—and what happened to him after birth—nurture. The former is fixed in the germ, irremediable; the latter is the product of environment, and remediable. The law of ancestral inheritance and Mendelism teach us that we can only predict the racial value of an animal or an individual human being by a study of the ancestral stocks as well as the morphological characters and conduct of the individual in whom, as Lucretius said, are concealed many first beginnings.

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